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BY-PRODUCTS.

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Editorial Notes

Anticipation

On purely economic grounds there is no reason to suppose that 1936 will differ from 1935 unless it be that trade will still further increase. The stabilization of Government has been a valuable help in maintaining business confidence. Although a million houses have been built recently, forthcoming building operations are still expanding in volume, and that in itself is a good augury for the Gas Industry. The monetary conditions which have assisted in the general expansion of trade continue. What is perhaps even more important is that last year witnessed the most definite upward trend in commodity prices that has occurred at any time within the last four or five years. Prices of iron and steel have risen and are likely to rise further; and those undertakings in need of plant which have delayed placing their orders may find that the delay has cost them quite a lot of money. Those who remember how much we longed for a rising market during the darkest days of the industrial depression will now take note that the return to prosperity has not followed a rising market, but that the rise in prices has followed returning prosperity. This prosperity will be still further helped by the confidence that comes with steady market rises. The only adverse factors appear to be the effect of " sanctions " and of the present lamentable war and, perhaps even more important, the possibility of trouble in the coalfields. The Gas Industry is still just a little chary of spending capital on new plant; an industry that has never known the breath of real adversity is perhaps apt to be more easily stampeded in times of depression than are those industries that are subject to the fluctuating trade cycles. The Gas Industry, however, need fear nothing. During the lean years it has been wisely led, it has developed its organization for gas sales both domestic and industrial, and the Fuel Reasearch Board in its annual report has borne testimony to its technical efficiency. Confidence and hard work are needed.

Yet it is to be deplored that the Industry has still some " passengers "—still a few who are brakes to progress. It still suffers in some quarters from a parochial outlook. Built round the village pump, certain undertakings have never moved from it. The industries of the country are tending to work in collaboration and by mutual assistance rather than by competition. As we have long maintained, the Gas Industry is a fuel industry; but it is only one among several fuel industries. As a fuel industry, we cannot now be oblivious to what other fuel industries are doing. Shall we sell gas only or shall we be a real fuel industry and sell gas and coke? We do not mean " dispose of " the coke, but sell, by conscious and sustained effort, both gas and coke. The gas and coke loads are not mutually exclusive even when the coke is used in the open fire. The gas-lit open coke fire displaces the coal fire and not the gas fire, while the gas used for lighting the fire gives valuable assistance to the gas load. What can be done by conscious effort is shown by the fact that in spite of the very mild winter of 1934-35, the sale of coke in the London area actually increased by 400,000 tons. Those who agree with what has already been done in the London area have shown themselves to be believers in the Gas Industry as a fuel industry; let them carry their conviction over the whole country.

Coke Oven Gas and Coke

Realization that the Gas Industry is a fuel industry involves reciprocal collaboration with other fuel industries. It is immediately evident that the industry most closely associated with the Gas Industry is that of by-product coking. Already gas-works are taking as much coke oven gas as they are able, to the extent of 18,000 million cu.ft. annually, which, by allowing a yield of 17,000 cu.ft. (including water gas) per ton of coal carbonized—the average make throughout the whole Industry—amounts to over 1,000,000 tons of coal per year. The collieries are thus collaborating with the Gas Industry to this extent. The plight of the collieries is now pretty well recognized, and it is safe to say that nothing but advantage could accrue to them by still fuller collaboration between the fuel industries.

When dealing with the coke problem at this time last year attention was directed to the medium temperature process which had been developed by the coke oven industry. There have been important developments of this process abroad, but not as yet in this country. Nevertheless, a significant observation contained in the Fuel Research Board's Report must be noted: " The open domestic fire is still a national institution, but is responsible for much direct and indirect waste of fuel, as well as for most of the costly smoke nuisance. The increasing use of gas, coke, and electricity is steadily improving the position, and further developments in the production of easily combustible coke and of suitably designed open grates will accelerate the improvement. The output of free-burning smokeless fuel produced by carbonizing coal

at temperatures lower than those of coke oven or gas-works practice is steadily increasing." Contrast this with the retrograde campaign of the Coal Utilisation Council, to increase the burning of raw coal in the domestic hearth. It is evident that greater collaboration between the fuel industries is desirable. Coke ovens are likely to make domestic coke in large quantities, and if they also make the medium temperature high-volatile product their position might become very strong. It is highly desirable that the gas coke and oven domestic coke interests should collaborate, and we confidently expect this collaboration to be one of the achievements of 1936. Meanwhile, the sales of Coalite for 1935 (year ended Oct. 31) were 14% greater than the figures for the previous year, and the total volume of orders received during the twelve months constitutes a new record. It may with propriety be suggested that if fuel of this character were available at prices similar to that of gas coke or of house coal, the demand would advance rapidly. In medium temperature carbonization the coke oven industry has a carbonizing process that might achieve this object. There is now definite need for collaboration.

Gas Technologists

Among the varied selection of problems the coming year will bring us, we find there are some of purely domestic character. There is, for example, the vexed question of the status of many fuel technologists. We referred to this at the time of the Autumn Research Meeting of The Institution of Gas Engineers and expressed the hope that suitable action should be taken. Our Industry depends upon many things for success. Plant must be designed and built, distribution systems and services must be installed, gas must be sold to the domestic consumer, and (by a different method) to the industrialist; to sell gas we must have the appliances to burn it efficiently, and these must be designed and manufactured; to make gas efficiently and to use it efficiently research is necessary, chemical control is necessary; the Industry cannot prosper without shrewd financial policy; at the head there must be sound management—and management to-day is an art in itself with its own psychological principles. Among all these varied employments, engineering as such is apt to be over-emphasized. Yet what the manager of a gas undertaking needs to-day is a sound training in fuel production and utilization, and the possession of that large ingredient of business acumen known as common sense. It is only necessary to instance the sister industry, by-product coking, where many of the best installations are under the control of men who are chemists by training. Emphasis for those employed by gas undertakings should be on general gas technology, not solely on the design of structures or the mechanics of power transmission.

There is also the question of research. The Industry spends a considerable amount of money on research, and very valuable results are secured. Do the individual undertakings, apart from those which are blessed with scientific staffs of their own, take the trouble to understand and apply the discoveries of the investigators? Research men are, perhaps, prone to wrap up their work in much verbiage and many diagrams and tables, though it is difficult to see how the results of research could be better presented than is the case to-day in the Institution "blue books"—with their summaries, introductions, and amplified statements. We suggest, however, that it would serve a useful purpose if, after a piece of research has been completed—it may be after some years of work—the really important conclusions as they affect gas practice were summarized for the guidance of practical gas men. This would expedite the turning to practical account of the researches carried out by the Industry. We need an interpreter to connect the man with a spanner and the man with a test-tube.

The Gas Industry faces 1936 with a high heart. It enters a new world, for perhaps never did the world change so rapidly as to-day. Coal, the essential raw material, will increase in price, but it is increasing in purity, and one day it will be generally recognized that coal blending is as essential a part of the gas-making art as is the blending of tobacco or tea in those trades. Competition is increasing, but never did so many people and so many industries realize the value of gaseous fuel. Stabilization of coke prices, and replacement of raw coal by smokeless fuel are appreciably nearer in 1936 than they were in 1935. A new sister industry has arisen in hydrogenation, trade is improving, and the building industry is flourishing. Ceaseless industry is necessary, untiring watchfulness to protect our interests, but never were the prospects so bright.

Therm Meters

An interesting clause in the Parliamentary Bill which is being promoted by the South Metropolitan Gas Company is concerned with how gas consumption shall be ascertained. The clause provides for an alternative to the normal method of arriving arithmetically, from the cubic foot reading of the meter, at the number of therms supplied. The proposal is to use a meter which, while still measuring the consumption by cubic feet, will do the arithmetic calculation mechanically and show the result directly on a dial plate indicating therms and fractions of a therm. A meter indicating therms might well be of help to our Industry. It can be argued that it is too much to expect consumers to do the sum at present necessary if they are to check their accounts by the reading of their meter; and the lack of interest which necessarily follows cannot be regarded as strengthening the bonds of mutual understanding. Again, it can be argued, surely it is logical that the index of the meter should be in the same terms as the basis of charge and the accounts rendered. At the same time it is maintained that the mechanical device necessary to effect this end is a very simple calculating machine.

According to the proposal the meter would contain, in addition to the cubic foot index dial, a dial plate for reading therms direct and also a statement of the calorific value of the gas to which the mechanical calculating device is applicable. Such a meter would then be stamped for the supply of gas of the calorific value stated thereon. It would, in brief, be a legal therm meter. Should the Company decide to alter the declared calorific value, then adjustment or replacement of any meter would be carried out at the Company's expense. Provision is made to cover the period which may elapse between the date of the alteration of calorific value and the date of the alteration of the meter.

We are of opinion that it would be a definite advantage to the consumer to be able to check-up his consumption by a direct therm reading on his meter. We also suggest that it would enhance this advantage if the therm mechanism could be set back to zero after each official reading of the meter. Without any reference to meter card and need for a subtraction sum he would know at any time exactly how he stood and what to expect from the next account rendered by the undertaking. On the other hand, we do need greater simplicity in meter construction—a reduction in types to maintain production costs as low as possible. The work of the Meters Committee of The Institution of Gas Engineers in this connection was reported at the Autumn Research Meeting last November, when the Industry was strongly urged to adopt universally the "I.G.E. Specification for Gas Meters for Domestic Consumers." During the discussion

on this matter the point of view of the meter maker was put forward by Mr. H. E. Bennet and Colonel Peebles. Mr. Bennet mentioned that a large number of undertakings insist on having nothing but standard meters, an even larger number insist on the large-case high capacity meter, while others insist on the small-case high-capacity meter. This means that the maker must carry three stocks. A greater difficulty, however, he continued, is presented by the number of gas undertakings having individual specifications—not necessarily entire specifications, but specifications dealing with some special feature to be incorporated in the meters they buy. One maker, said Mr. Bennet, has actually to carry twenty-one stocks. Should it, therefore, eventually be decided that the advantages of the therm meter outweigh any additional cost, we hope that this cost will be kept at a minimum by general agreement as to the form of therm attachment it is desirable to adopt.

Preparedness

FOLLOWING upon record sales of appliances in 1934, gas undertakings generally throughout the country have enjoyed a still greater volume of sales during the past twelve months. This, of course, is indication of the rising standard of salesmanship in our Industry and of the ever-growing appreciation by the general public of the merits of gas as a domestic fuel for all purposes. Last winter was, of course, unusually mild—in fact, the mildest on record, and consequently the Gas Industry did not reap the looked-for results of its keen sales work. The effect, however, has been felt in no uncertain way during the cold snap which preceded the Christmas of 1935, and it must have caused many an undertaking to consider very seriously indeed whether their manufacturing capacity is sufficient to cope with demand during favourable—by which we mean cold—weather.

An example of preparedness, however, is provided by the Buxton Gas Department. In our news pages will be found a photograph of the opening by the Mayor of a new carbonizing plant on Dec. 18; and the putting of this plant into operation must have greatly eased the mind of Mr. F. G. Shaw, the Engineer and Manager. Prior to Christmas he experienced daily increases over the corresponding days of 1934 of anything from 15 to 55%. With heavy frost on Christmas Eve the consumption rose from 541,300 cu.ft. to 842,000 cu.ft. Other instances of remarkable jumps in demand are recorded in this "JOURNAL," notable, and again on Christmas Eve, being Edinburgh's increase of over 2,000,000 cu.ft. If we have a February such as that of 1929, will every gas undertaking be equipped satisfactorily to cope with the demand which would inevitably occur?

Railway Electrification

THE Electrical Development Association recently published a plausible booklet called "The Case for Electrification of the Railways." It is a skilful piece of special pleading. The author begins with a short historical survey, tracing the progress of electricity from its early application to telegraphy down to its invasion of the lighting and heating business, its industrial use for power and heat, and the employment of the electric drive for ships.

This picturesque beginning is not mere window dressing. It is designed to show that "many electrical developments now accepted without question were at first regarded as essentially unsound and extravagant, and owed their initiation to the efforts of pioneers who ignored the body of orthodox opinion." The implication is that those who oppose the electrification of railways will be confounded in their turn, and shown up for the scorn of posterity as obscurantists and die-hards. Approaching the problem in this spirit, the author gives short shrift to a railway engineer who referred to electrification as a disaster. "In precisely such language," we are told, "did the stage coach enthusiasts of a hundred years ago refer to the steam locomotive."

The conditions which favour main-line electrification are then marshalled in a telling way. The grid has enabled railway companies to obtain bulk supplies of power at any part of their systems; and this facility has been enhanced by the Act of 1934 permitting the Central Electricity Board to supply electricity direct to railway companies instead of through the intermediary of distributing authorities. The success of suburban electrification (including the Brighton line) is described, and the Government is commended for its guarantee of £40,000,000 to the London Passenger Transport Board for electrification and other developments.

At this point the author poses a crucial question: Why is electric traction beyond controversy for busy suburban lines, but still a subject of debate for main lines? The answer is given in the "half-humorous" observation of an American engineer that the whole British railway problem is really a suburban one. In other words, what is good for the suburban lines is good for the main lines, too. It may be objected here that the electric locomotive offers no advantage in speed over the modern steam locomotive. The author admits it, but adds that "record-breaking on rail, though useful as an occasional publicity stunt, is more than doubtful as a workaday policy."

We are then treated to a sketch of the future of rail electrification. Provincial centres will follow London's example by electrifying suburban services. Then (following the example of the Southern Railway) the converted suburban services will be extended over main lines to reach other towns, until nearly the whole system is electrified. . . . Nearly, but not quite. Branch lines, which are lightly loaded and therefore not a profitable proposition, will either be closed down or serviced by oil-electric locomotives.

Why Hesitate?

THEN comes the pertinent question: Why do the railways hesitate? Again the answer is simple. "Directors, engineers, and traffic managers have been reared in the steam tradition. 'To men who live, move, and have their being in steam, the advent of electric traction is bound to be unwelcome, even though it promises to bring a financial benefit." This picture of railway directors refusing to handle increased profits because of their affection for steam is not without pathos.

Finally, we are shown the advantages of immediate action. Cheap money is available in abundance. Materials are abnormally low in price. Town-planning demands smokeless railways. If road congestion is to be relieved, passengers and goods must be attracted to clean electric railways. Moreover, electrification of railways is bound to stimulate employment. The peroration is worth quoting: "Railway electrification is everybody's business. Consequently it behoves all the various interests—shareholders, municipal corporations, ratepayers' associations, industrial organizations, trade unions, and others—to take every possible step to bring pressure to bear upon Parliament and the railway companies to press forward with the modernization of the railways."

As an essay in propaganda, this booklet deserves serious consideration. It is to be hoped that the other side of the case will be put with equal force to the interests which are thus urged to take political action. The Weir

Commission mentioned £340,000,000 as the sum necessary for main line electrification, and it was admitted that the whole scheme was speculative in character. There has been no suggestion that the costs of transport will be cheapened.

The only substantial advantages of the scheme would accrue to the electrical industry. The fact is that the development of electricity in this country has been aided so far by artificial stimuli—the first being the conditions created by the War, and the second the political considerations which resulted in the adoption of the Grid System. Now a third tonic is sought in the shape of railway electrification. Railway shareholders and others should be made to realize that main line electrification is a gamble which may result in financial loss and in the exploitation of the railways in the interests of electricity.

Fifty Years Hence

THOSE who have no expectation of being still among the living half-a-century from now, may read with envy—they certainly will do so with interest—the description of Britain in 1986 contributed by J. D. S. Alan to the *Sunday Dispatch*. Extraordinary this pen-picture certainly is, but, judging by the giant-strides of science during the past fifty years, everyone will be prepared for big things in the next half-century. Scientific progress will be great, we know; any element of doubt that may arise will be with regard to the precise directions it will take.

Vast progress in methods of transport—certainly. We are fully prepared to believe the statement under an illustration of Piccadilly Circus fifty years hence—namely, that " pedestrians would no more dream of walking on the road than on the railway lines." Most of them would not dream of doing so at present, were an alternative offered. To-day it is the pedestrian's misfortune, and not his fault, that he has to perform his peregrinations at ground-level. In 1986, however, Oxford Street will be no wider than it is to-day, but there will be " an extra double track for motors, because the footpaths will have been raised on brackets, with bridges every hundred yards." The gas showroom, and other like premises, will require more window displays; for the shops will " have windows at two or more levels—the lowest, opposite the road, for passengers in vehicles, and the others level with the footpath."

It will be " a land without smoke, without dirty fog, and without the illness and mortality caused by breathing impure air." This may well be, inasmuch as one foresees, in the years to come, enormous increases in the use of gas, coke, and other smokeless fuels. We shall also expect to find gas used in much greater quantities for street lighting purposes, for the description tells us that " no lights will be used by vehicles in London by night, because the streets will be fully lighted by a glare—and shadow—proof system, which will reveal objects in natural colour." We visualize gas being used, because vehicles without lights will have no safeguards against " black-outs," and the writer of the article does not say anything about electricity having rid itself, in the interval, of this embarrassing proclivity. Even though cars and omnibuses had " bumpers all round, like miniature cars at fairs," and were " so strong that a really bad bump or overturning seldom had fatal results," liability to sudden " black-outs " could hardly be regarded with equanimity by vehicles " shaped like eggs " travelling in all directions about the roads by night, without lights.

The picture drawn of England fifty years hence is an intriguing one, which displays great ingenuity on the part of the author. Many of the suggestions make strong appeal. Should the conditions set out be realized, golfers in 1986 will be specially happy, for although, owing to pressure upon land, fairways will be narrow and netted, and a full-size course will occupy only a quarter the original space, " balls landing in the rough will ring a bell intermittently, and flash lights until recovered." The author also suggests that electric heating of the ground will have " made Britain a farmer's paradise." In that case, we imagine, a sustained failure of current at certain times may have much the same devastating effects upon vegetation as does a sharp frost in May under existing conditions. We wonder if farmers would be any happier were they able to shift the blame in this way.

Stock and Share Prices

THE space which from long custom has been allotted in the " JOURNAL " to Stock and Share quotations has set a severe limit on the number of securities which we were able to include, and there have in the past been interesting quotations which we have been forced to omit.

Those who are interested in this aspect of the Industry will find in this issue that the Stock Table begins on its customary page at the back, but that, by certain re-arrangements, we have been able to devote also the turnover to market quotations, and thus include week by week a very much wider range of securities. What amounts to almost doubling the available space has enabled us to go well beyond the " Official Quotations " list, and to give the prices of Stocks and Shares which come in the London " Supplementary " list, as well as of many others which have quotations on the Provincial Exchanges.

The re-arrangement at the back of the " JOURNAL " has necessitated allotting a new fixed position to the Index to Advertisers, and this will henceforth be found on the last right-hand page before " Contents."

1936 " JOURNAL " DIRECTORY

The first number of the " JOURNAL " in each month will contain announcements of changes in the particulars given in the 1936 " JOURNAL " Directory, thus enabling our readers to keep up-to-date the information in regard to personnel, &c. A list of alterations received too late for inclusion in the 1936 edition has been circulated with each copy of the " Calendar and Directory," and the undernoted items are additional to these :—

Page 32.	HEBDEN BRIDGE. T. H. Nield, E. & M., resigned
Page 52.	PENRITH. G. Hudson appointed E. & M.
Page 54.	PORTSMOUTH. Amalgamated with Gosport Company—Re-named the Portsmouth and Gosport Gas Company.
Page 84.	GRANGEMOUTH. T. A. Rowan appointed E. & M.
Page 92.	THURSO. T. A. Rowan, M., resigned.
Page 96.	MAGHERAFELT. T. Broderick appointed M. vice P. Drohan, resigned.
Page 98.	THURLES. P. Drohan appointed M. vice M. Spittle retired
Page 148.	SCOTTISH JUNIOR GAS ASSOCIATION (WESTERN DISTRICT). W. Kirk (Motherwell) appointed Hon. Secretary and Treasurer vice J. K. Campbell resigned.

Happiness and Prosperity in 1936

PERSONAL

Mr. HAROLD E. BLOOR, B.Sc., B.Eng., Engineer, Manager, and Secretary of the York Gas Company, has been appointed by the Directors to a seat on the Board.

* * *

His many friends in the Gas Industry will join us in congratulating Mr. REGINALD GEORGE CLARRY, who has been created a Knight Bachelor in the New Year's Honours List in recognition of his political and public services. Mr. Clarry is well known as Chairman of the British Road Tar Association, and has represented Newport (Mon.) from 1922 to 1929 and since 1931.

* * *

The Industry has lost one of its foremost publicity men in the departure of Mr. A. P. RYAN from the Gas Light and Coke Company to take up the position of Assistant Controller of Public Relations to the British Broadcasting Corporation, where he will help the recently appointed Controller, Sir Stephen Tallents. Mr. Ryan, who is 35 years of age, has been Publicity Manager of the Gas Light and Coke Company for the past five years, during which period the forceful publicity afforded to gas in the London newspapers through the medium of the well-known figure of Mr. Therm has redounded to the benefit of the Industry as a whole. The many friends he has made in his all too short career with the Gas Industry will join us in wishing Mr. Ryan every success in the new duties which he commences in February.

* * *

Mr. GERALD HUDSON, Assistant Manager to the Normanton Gas Company, has been appointed Engineer and Manager to the Penrith Gas Department in succession to Mr. J. Corrigan, who, as announced recently in these columns, has secured a similar position at Brighouse. Mr. Hudson commenced his career in the Gas Industry at Newark, subsequently becoming Assistant Engineer and Manager to the Hessle Gas Company. He has been at Normanton since 1921.

* * *

A high tribute to the work of Alderman BARLOW, Chairman of the Accrington and District Gas Board, was paid at the annual meeting, on Dec. 19, when he was re-elected to the position for a further term.

* * *

Mr. H. B. MORRIS, Assistant Engineer to the Loughborough Gas Department, has been appointed Assistant Manager to the Basingstoke Gas Company. Mr. Morris has been presented with a mahogany bureau by the Staff and employees of the Loughborough undertaking.

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In connection with the merging of the Portsmouth and Gosport Gas Undertakings, which from to-day become the Portsmouth and Gosport Gas Company, Mr. EDWIN ALLISON, M.Inst.Gas E., has been appointed Engineer, and Mr. C. W. HOBBS has been selected as District Manager in charge of the Gosport Office. Mr. T. CARMICHAEL, M.Inst.C.E., has relinquished his position as Engineer to the Portsmouth Company, but will be the General Manager to the combined Undertaking.

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Mr. HARVEY THOMAS HESKETH, Chairman of the Malpas Gas Company, and Mrs. Hesketh have just celebrated the golden anniversary of their wedding.

* * *

We learn that Mr. THOMAS A. ROWAN, Manager of the Thurso and Golspie Gas Light Company, was on Dec. 23 appointed by Grangemouth Gas Committee to the position of Manager of the Grangemouth Undertaking in succession to Mr. A. Cuthbert who, as announced recently in the "JOURNAL," has been appointed Manager at Stirling. Mr. Rowan will take up duty on Jan. 15. Mr. Rowan, who is a native of Girvan, was trained at Dumbarton, and was for five years Assistant Manager at Helensburgh, going to Thurso three years ago.

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The retirement is announced of Mr. P. R. CHALMERS, Manager of the Kelso Gas Company for the past 34 years. Before going to Kelso, Mr. Chalmers was at Castle-Douglas and Coupar-Angus, and has spent 48 years in the Gas Industry. His son is Manager of the Dunblane Gas Company.

* * *

Mr. MICHAEL SPITTLE, Manager of the Gas-Works at Thurles (Co. Tipperary), has retired on pension after over half a century's service. He is being succeeded by Mr. P. DROHAN, Manager at Magherafelt (Co. Londonderry), who is a brother of Mr. Maurice Drohan, Manager of Cavan Gas-Works, whose tragic death is recorded in our obituary columns this week. Mr. T. BRODERICK, Assistant at Wicklow Gas-Works, has been appointed Manager at Magherafelt and Mr. WILLIAM GRIFFIN, late of the Tipperary Gas-Works, goes to Wicklow.

Obituary

A Director of the Bedford Gas Company for the past 46 years and Chairman for 36 years, the Rev. PAUL WILLIAM WYATT, M.A., passed away on Dec. 29 in his 81st year.

* * *

Mr. MAURICE DROHAN, Manager of Cavan Gas-Works, lost his life in a gallant attempt to rescue a stoker who was gassed in a purifier at the Gas-Works. Mr. Drohan observed that the stoker was overcome and, with the assistance of another employee, pulled him to safety. The stoker has now regained consciousness and is recovering, but Mr. Drohan inhaled gas to such a degree that he succumbed. Mr. Drohan, who leaves a widow and eight children, was formerly Manager of the Gas-Works at Longford and had only been a month at Cavan.

Forthcoming Engagements

Jan.

7.—I.G.E.—Research Executive Committee, 2.30 p.m.
11.—SCOTTISH JUNIOR ASSOCIATION.—Joint Meeting in Glasgow. Address by Mr. H. C. Smith.
13.—I.G.E.—Finance Committee, 1.45 p.m.; Membership Committee, 1.45 p.m.; General Purposes Committee, 3.15 p.m.
14.—I.G.E.—Council Meeting, 10 a.m.; Gas Education Committee, 4 p.m.
15.—I.G.E.—Education Executive Committee, 10 a.m.
15.—B.C.G.A.—Executive Committee Meeting, 11.30 a.m.; General Committee Meeting, 2.30 p.m.
16.—MIDLAND JUNIOR ASSOCIATION.—Meeting. Paper by Mr. B. Green.
16.—S.B.G.I.—Council Meeting at 2.30 p.m.
16.—B.C.G.A.—South Wales District Meeting at Cardiff.
18.—WESTERN JUNIOR ASSOCIATION.—Meeting at Bath. Paper by Mr. F. G. O'Neill.
18.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting at Oldham. Paper by Mr. R. E. Stott.
22.—B.C.G.A.—Northern District Meeting at Newcastle-upon-Tyne.
23.—B.C.G.A.—Midland District Meeting at Birmingham.

Jan.

24.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting. Paper by Mr. T. A. Wolfe.
25.—WALES AND MONMOUTHSHIRE JUNIOR ASSOCIATION.—Meeting. Paper by Mr. C. F. Petersen.
28.—B.C.G.A.—Manchester District Meeting at Manchester.
29.—B.C.G.A.—Yorkshire District Meeting at Leeds.
30.—B.C.G.A.—Eastern District Meeting at Cambridge.
31.—I.G.E.—Liquor Effluents and Ammonia Committee, 11.15 a.m.; Joint Research Committee, 2.30 p.m.
31.—B.C.G.A.—South-Western District Meeting at Exeter.

Feb.

6.—MIDLAND JUNIOR ASSOCIATION.—Meeting. Paper by Mr. G. C. Pearson.
8.—MANCHESTER AND DISTRICT JUNIOR ASSOCIATION.—Meeting at Darwen. Paper by Mr. J. A. Derbyshire.
8.—SCOTTISH WESTERN JUNIOR ASSOCIATION.—Meeting.
14.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting. Paper by Dr. F. J. Dent.
15.—SCOTTISH WESTERN JUNIOR ASSOCIATION.—Annual Social.

News in Brief

Contributions amounting to over £32 have been subscribed to various local charities during 1935 by the employees of the Airdrie Corporation Gas Department.

An Issue of £33,000 4% Redeemable Debenture Stock, 1950-1960, and £17,000 5% Consolidated Preference Stock by Tender, Minimum Price £110 per £100, yielding at that price £4 10s. 11d.%, is announced by the Dudley, Brierley Hill, and District Gas Company.

Special Courses of Evening Lectures are to be held during January, February, and March at the Department of Coal Gas and Fuel Industries (with Metallurgy) at the University of Leeds. Further reference to these courses is made in our advertisement columns to-day.

In His Monthly Manufacturing Report, the Engineer of the Elgin Gas Department states that the increase of gas manufactured during the month ended Dec. 15 was 1,269,500 cu.ft.—or 11%. This shows an increase, since 1928, of 5,342,700 cu.ft., or 71% for this particular month.

Over Six Hundred People attended the annual dance of the Alliance and Dublin Gas Company at which the guests included the Lord Mayor of Dublin and Mr. W. J. Grey, General Manager and Secretary of the Company. Mr. C. H. Leach, Assistant Secretary of the Company, was Chairman of the organizing committee.

The Gas Consumption at Penrith during Christmas week eclipsed all previous records. For the Penrith Gas Department the days before Christmas are normally very heavy ones, but on this occasion the very severe frost placed still further demands on the resources of the manufacturing plant. On Christmas Day the highest hourly output was recorded, 29,800 cu.ft. being sent out between 12 noon and 1 p.m.

Shareholders of the Adlington Gas Company have decided to endorse the action of the Directors in selling the Undertaking to the Chorley Corporation at a figure agreed between the two bodies. Recently the Chorley Corporation sought borrowing powers for an extra £160,000 for purposes of gas-works reconstruction and expansion. New mains will be laid at some future date for the development of the Duxbury estate which adjoins Adlington, and Adlington will eventually receive its supply of gas direct from Chorley.

A Christmas Gas "Drive" has been in full swing in Barbados where Mr. J. W. Brown, M.Inst.Gas E., M.I.Chem.E., F.F.Sc., directs the destinies of the Barbados Gas Company, Ltd. From Nov. 18 to Dec. 18 on all gas cooking installations the Company allowed 15% discount. For a small rental the consumer can enjoy the benefits of gas cooking until May 18, but, if he is not satisfied, the cooker will be removed at no further cost. Gas is supplied at half-price when the deposit has been paid and the balance is paid by easy instalments.

There was a Record Output of gas by the Edinburgh Corporation Gas Department on Dec. 24 of 16,062,000 cu.ft., which was over 2 million cu.ft. more than the same day of 1934. The previous record output by the Department was on Dec. 23, when the figure was 15,055,000 cu.ft. It is also of interest to recall that on Hogmanay, 1931, the gas output was 14,347,000 cu.ft., so that this record was an increase of 12% on the 1931 figure. Since Dec. 15 of last month the output of gas is up by 17 million cu.ft., and from May 15 to date the increase is roughly 4·39%.

Attractive Publicity Matter recently published by the Newcastle-upon-Tyne and Gateshead Gas Company includes book-markers distributed to lending libraries, invitations to a series of "Christmas Fare" cookery demonstrations, folders advertising cheaper gas under the new domestic tariff, which were distributed to 60,000 of the Company's quarterly consumers, and folders advertising larger cash rebates which were distributed to 140,000 prepayment consumers. We are indebted to Mr. T. P. Ridley, Secretary and Commercial Manager, for samples of this matter.

The Directors and Past and Present Employees of the Bideford Gas and Coke Company, Ltd., to the number of some eighty, commemorated the Company's centenary by dining together on Saturday, Dec. 21. The dinner followed the opening by Mr. M. J. Durant, Chairman of the Company, of a specially erected room, to be known as the Centenary Clubroom, for the use of the employees. In doing so the Chairman expressed the hope that the Clubroom would lead to closer co-operation in leisure hours. The Company gave the materials for the construction of the room, and the work of erection was mostly done voluntarily by members of the staff.

Amalgamation and Grouping

Chorley and Adlington.

We learn from a local correspondent that shareholders of Adlington Gas Company have unanimously agreed to the recommendation of the Directors to dispose of the Undertaking to the Chorley Corporation. The Chorley Town Council approved the acquisition of the Undertaking in October, subject to agreement by the shareholders. The price has been given as £13,380, *plus* compensation.

Portsmouth and Gosport Gas Companies.

The proposals for the acquisition of the Gosport Gas Undertaking by the Portsmouth Gas Company, which were unanimously agreed to at the Extraordinary General Meetings of stockholders of both Companies on Aug. 7 last, have now received the sanction of Parliament. The Board of Trade Special Order authorizing the transfer of the Gosport Undertaking has been issued and the amalgamation therefore takes place to-day, Jan. 1, from which date the Undertakings will operate under one Board of Directors and give service to a population of nearly 350,000. The name of the combined Undertaking will be the Portsmouth and Gosport Gas Company.

The Chairman, Dr. F. E. Beddow, J.P., and his co-Directors are confident that the merging of the Undertakings under one control will be beneficial alike to stockholders, gas consumers, staff, and employees. A common commercial and technical policy will be applied by the Board throughout the whole of the area of gas supply and, generally speaking, the Portsmouth charges for the carcassing of houses and for the laying of service pipes will obtain, and Portsmouth prices for gas appliances and conditions of service generally will apply in the added areas of the Borough of Gosport and the districts of Lee-on-Solent, Fareham, Wickham, and Bishops Waltham.

Staff appointments are recorded in our Personal column to-day.

Newcastle Basic Price Revision

Tyneside Authorities' Application

Tyneside local authorities are making application to the Board of Trade for Orders revising the basic prices for gas supplied by the Newcastle-upon-Tyne and Gateshead Gas Company under the Newcastle and Gateshead Act, 1929. The application is for a reduction of 0·2d. per therm.

Mr. T. P. Ridley, Secretary of the Gas Company, states that the application is purely a formality and does not imply in any sense any reduction in rates to consumers. As announced in the "JOURNAL," the scale of charges for gas supplied to consumers was reduced by the Company last September.

Western Junior Gas Association

Meeting at Torquay

On Dec. 14, members of the Western Junior Gas Association assembled at the Hollacombe Works of the Torquay and Paignton Gas Company where they inspected the 3-million cu.ft. per diem West's continuous vertical installation.

Later they inspected the Company's showrooms which are certainly among the finest in the West of England, and, in a town like Torquay, are an asset to the whole Gas Industry. After tea had been served the thanks of the Association were moved by the President, Mr. J. H. Dyde (Plymouth), who mentioned that this was the first time that the Association had visited Torquay, and complimented the Company on the magnificence of their showrooms. Mr. R. C. Taylor thanked the President for his kind remarks, adding that they were fortunate that day in having one of their Directors, Mr. Robert Beynon, who would address them. He referred to the fact that Mr. Beynon had recently completed fifty years with the Company.

Mr. Robert Beynon said how pleased he was to see such a good number present, and that it would give him very much pleasure to convey the thanks of the Association to his co-Directors. They felt, in extending the invitation, that Torquay had something to show, and he was glad it had proved instructive and interesting. He referred also to the value of these meetings to members of the Industry.

Morecambe's New Open Air Swimming Pool May be Heated by Gas.

The Morecambe and Heysham Council, at a recent meeting, fully discussed the question of the heating of the water in the new Swimming Pool, which it is hoped will be completed in time for the coming season.

It was decided that the baths would not be heated this year, but instructions were given to the Architects to prepare the necessary foundations to carry the heating plant.

The Council further resolved that if in the future it proved desirable to heat the water, then this should be carried out by means of a gas installation, and the Gas Engineer was instructed to lay the necessary mains for this purpose forthwith.

Illuminating Engineering Society

Photographic Representation of Street Lighting

On Dec. 17, Mr. R. G. Hopkinson read a Paper at a joint meeting of the Illuminating Engineering Society and the Royal Photographic Society in which he stressed the importance of establishing a system of photographic representation of street lighting installations which would give a really qualitative record of engineering value. It has been a cause of comment, voiced by the Authors of recent Papers on street lighting, that street light photographs are unreliable as a means of studying the characteristics of an installation. In the absence of any system of representation the photographer has produced the impression he received of the street during his brief acquaintance with it, or has concentrated on the pictorial effect. The aim is to develop a logical system of representation derived from first principles, so that photographs prepared in accordance with the system will give a qualitative record of the installations they represent, as well as being comparable amongst themselves. Such photographs may not always make the most attractive pictures. A more pleasant result might be given by a brighter and pluckier print than would be produced by the system, but an examination of the print and of the installation from the same viewpoint as that from which the photograph was taken would show that the more pleasant result is not necessarily the more accurate from an engineering point of view.

The Author gave as the requirements of a true photographic representation the following points: Firstly, the photograph must be viewed from such a distance that subject is seen in correct perspective. Secondly, the brightness gradation on the print must be the same as in the subject. Thirdly, the detail visible in the highlights, and also in the shadows, should be strictly comparable with that visible in the subject.

If fulfilled, these three points would ensure the production of a photograph satisfactory in every way. The Author dealt with the technical details involved, including the choice of materials and the production of prints, and showed a number of slides to illustrate his recommendations.

Consumers' Gas Company of Toronto

Sales of Gas Appliances Up 37%

The report of the Directors of the Consumers' Gas Company of Toronto presented at the eighty-seventh annual meeting of the Company stated that the gross earnings for the year have been more than sufficient to pay all costs of operation including taxes, uncollectable accounts, interest charges, the cost of actual repairs and renewals, and the regular dividend. The sales of gas appliances show a very satisfactory increase in volume, being 37% greater than the sales of last year. The activities of the Commercial Department in promoting and stimulating the use of gas among all classes of consumer were continued in a vigorous manner throughout the year. Interest in the cooking demonstrations of the Home Service Department has been well maintained and the large attendance at the lectures is ample proof that the homemakers of Toronto appreciate receiving instruction in better methods for the utilization of gas in the home.

The President, Mr. Arthur Hewitt, who is well known to many gas engineers in this country, in the course of his Address said, "I regard the future outlook as decidedly promising. Any improvement in general business conditions, with the consequent restoration of purchasing capacity to large numbers of our domestic consumers, accompanied by further development of the potential market for water-heating, house-heating, refrigeration, air conditioning and the many other commercial and industrial uses for gas, should be reflected very quickly in greatly increased sales of gas."

Glover-West Verticals Inaugurated at Buxton

Many of our readers will, no doubt, have read in their daily papers of the severe weather experienced at Buxton, and will be glad to learn that the Buxton Gas Department have in common with other undertakings up and down the country reaped the benefit of the sudden cold spell experienced recently. Mr. F. G. Shaw, the Engineer and Manager, informs us that the Buxton Undertaking has been experiencing remarkable daily increases over the corresponding days of last year.

The following comparison is of great interest:

Buxton Gas-Works—Daily Output Xmas Week.

	1935.		1934.	
Dec. 22	658,200	cu.ft.	..	
,, 23	644,100	,,	563,800	cu.ft.
,, 24	842,300	,,	541,300	,,
,, 25	854,000	,,	634,700	,,
,, 26	678,700	,,	557 400	,,
,, 27	591,500	,,	482,800	,,
,, 28	606,000	,,	544,200	,,
,, 29	..		545,300	,,
	4,874,800	,,	3,869,500	,,

It was, then, in the nick of time that the new Glover-West vertical retort installation was inaugurated on Dec. 18 by the Mayor of Buxton, Councillor Edwin White, J.P., who is here seen charging the first retort. On the Mayor's right is the Chairman of the Gas Committee, Councillor A. J. Potter, over the Mayor's shoulder is Mr. Gaskell, of West's Gas Improvement Company, and standing next to him Mr. F. G. Shaw.

Gas Salesman's Pocket Book

1936 Edition

By to-day, Jan. 1, thousands on the sales and distribution sides of the Gas Industry will be in possession of the 1936 edition of the Gas Salesman's Pocket Book, and consequently will be able to start the New Year with added confidence. We say this because of what we have been told in the past about the utility of this compact and accurate reference which simplifies the salesman's task so much. The new edition of the Pocket Book is characterized by the customary thorough revision and by the inclusion of many new data and numerous tables and graphs.

Among the items included are "zones of comfort" charts for use with different types of gas heater; tables giving at a glance the actual oven temperatures at all settings of the different makes of cooker thermostat, and indicating what types of governor are applicable to various uses and suitable for fitting to different appliances; data on copper tubing and full technical and fitting data on refrigerators.

These are only some of the new features of a wealth of information compiled in such form as to enable the user of the Pocket Book to have at a second's notice just those facts and figures liable to be required at any hour of every day. The development which has taken place in gas distribution and domestic and industrial utilization during the past twelve months finds its reflection in the 1936 Pocket Book. Those who have not equipped themselves with this invaluable weapon of sales attack and defence should lose no time in grasping the opportunity and obtaining the Pocket Book from the "GAS JOURNAL" Offices.

The Ceramic Society

Meeting of Refractory Materials Section

The Autumn Meeting of the Refractory Materials Section of the Ceramic Society was held at the Rooms of the Chemical Society, Burlington House, London, on Nov. 20 and 21, under the Chairmanship of the Society's President, Mr. C. R. F. Threlfall.

Among the Papers was one by A. E. Dodd on "The Action of Water Vapour on Silica Bricks at High Temperatures and its Possible Industrial Significance." This deals with points of wide interest. The investigation was suggested by the failure of an open-hearth furnace roof. Nine different brands of steel furnace silica bricks were tested, being heated in a Hirsch furnace by gradual stages up to 1,500°-1,600° C., with steam passed through only after 800° C. was reached. The lower end of the specimens fell away after periods ranging from 20 minutes to four hours. Details are given concerning the further examination of the test-pieces, and the results of tests.

A complete explanation of the action of the water vapour involves consideration of at least four problems: (*a*) Nature of water vapour under the conditions of the test. (*b*) Its action on ferruginous compounds in the brick. (*c*) Its action on the calcium compounds in the brick. (*d*) Possible subsidiary effects, such as volatilization of silica, &c.

As regards (*a*) it is known that water is to some extent dissociated at high temperatures. Various suggestions have been made as to the probable products of the dissociation of water. The author states, as the most reasonable conclusion, that the dissociated products are molecular hydrogen and oxygen. As to (*b*) the most likely result seems to be formation of ferrous and ferric hydroxides from hydrolysis of the magnetic oxide (Fe_3O_4) in the materials. In connection with (*c*), calcium silicate may be produced, but would probably be decomposed by the water vapour at high temperatures. With respect to (*d*), several investigators have noted possible chemical and physical effects that might operate in conjunction with those previously mentioned.

Failure may arise from a high content of Fe_2O_3 in an atmosphere of water vapour, from a low content of lime, from some volatilization of silica, with immediate deposition in the amorphous form (this would account for the rotting effect), and water vapour causes a marked decrease in the viscosity of the bond, either by solution, by chemical action, or a combination of the two.

The trouble with the steel furnace roofs has been found to be associated with the use of coke-oven gas for heating. Coke-oven gas has a large percentage of hydrogen, which, of course, produces water vapour when burned.

Another communication was by J. H. Chesters and L. Lee, entitled "The Slag Resistance of Steel Works Refractories." Though primarily concerned with steel works, this Paper has also a bearing on such industries as gas manufacture, since gas retorts and coke-gas ovens use similar materials.

The failure of steel works refractories is usually due to slag attack. The use of an induction furnace in which any desired metal *plus* slag can be melted in contact with the refractory differentiates between the various materials and serves to show whether large-scale tests of new refractories or new slags can be made without risk of serious failure due to rapid slagging. Results of such tests and of microscopic examination, together with physical data—such as modulus of rupture at high temperatures and permeability—indicate lines of progress for developing refractories of high slag resistance. Experiences of the authors suggest that the use of small cylindrical pills is better than cones for melting-point determinations, since the former gives a better idea of the viscosity of the resulting melts. A modified pill test, in which the pill is a refractory-slag mixture, can yield much information in a comparatively short time. The method is described in detail, with reference to a specified problem.

Microscopic examination of slagged refractories often reveals that unexpected changes have occurred.

The authors conclude that a precise study of the action of slag on steel works refractories would require a great deal of knowledge about equilibrium conditions and reaction rates, which is not likely to be available in the near future. But it is possible to carry out:

(1) Safety tests on new refractories.
(2) Safety tests on new slags.
(3) Comparisons of slag resistances of various refractories, by means of cone and pill tests, and by simulating large-scale conditions in a small induction furnace. Physical tests, such as modulus of rupture at high temperatures and permeability, enable some idea to be gained of the probable influence of physical factors.

A further Paper, by Prof. F. H. Norton (of Cambridge, Mass., U.S.A.), was entitled "The Manufacture and Use of the Insulating Firebrick in the United States." It is only within the last five years that the advantages of placing the insulation on the inside of the furnace have been generally recognized. This led to the production of the insulating firebrick, which, though still in the development stage, has shown such fuel savings in intermittent furnaces that it is rapidly replacing firebrick in many services.

The porous structure needed in the insulating refractory may be produced by (1) Formation of bubbles in the soft mix. (2) Addition of a porous material like infusorial earth. (3) Burning out particles of organic matter in the mix. (4) Sublimation of solid particles in the mix.

The addition of infusorial earth to clay makes a light and porous structure, but limits the maximum temperature of use because of shrinkage. A porous grog addition can give a good structure, but is expensive and tends to lower the mechanical strength.

Probably the method most used for making the insulating firebrick is to mix a finely comminuted organic material with the clay. Wood sawdust is commonly used, but cork dust, peat, or coal may serve.

The clay used for the most refractory insulating firebrick is a pure sedimentary kaolin, which produces a snow white brick. Most of the other bricks are made from a fireclay which has less shrinkage and can be burned at a lower temperature than the kaolin. Porous bricks are made from ganister, and some work has been done on magnesite.

The author discusses the physical properties of bricks, advantages of insulating firebricks (which are fired up to 2,200° F., 2,600° F., and higher temperatures), limitations, methods of using the insulating firebrick in furnace design, &c. Some examples of use are briefly considered.

Correspondence

Gas in the Baking Industry

SIR,—With the approach of a New Year we are required to take stock and lay plans for the future. May I suggest the time is opportune for the B.C.G.A. or whatever Organization is concerned to talk "Gas and its advantages" in the prominent Bakery Journals?

With few exceptions oven builders in their advertising do not feature gas ovens or the conversion of existing ovens to gas firing. Many make a feature of oil firing; others are not concerned with the method of firing so long as they can sell ovens either coal, coke, oil, or gas fired, or electrically heated.

An intelligent programme of advertising would make the bakers think in terms of gas, supplement the efforts of those firms who advertise gas ovens, and encourage firms not partial to gas to entertain seriously this most desirable fuel. I use the word "intelligent" advisedly, having in mind the poor effort made in these trade journals to advertise coke in the past. A fair-sized central heating unit was illustrated—in my opinion an absolute waste of advertising space as very seldom is such a unit required by the average baker.

The Gas Industry would certainly benefit by this advertising, and the editorial effect would be valuable. The baking industry is worth serious attention. The fuel demand is very considerable.

For and on behalf of
Ellerstyle Engineering Company, Ltd.,
London, N. 1, W. ELLERD-STYLES,
Dec. 23, 1935. Managing Director.

Elimination of Sulphur from Coke

In which the Author suggests that sulphur in coke is likely to be one of the technical problems of our generation.

by
Dr. G. E. FOXWELL

Sulphur in coke is likely to be one of the technical problems of our generation. Coke oven technologists have been concerned for years to observe the increasing sulphur content of the coals they use in the manufacture of blast furnace coke. Formerly a coke containing more than 1% of sulphur was deemed to be unsuitable for the furnaces; that does not mean that no coke used contained more than that amount, but the limit was observed with fair exactitude. As higher-sulphur seams were mined and the low-sulphur seams were worked out, the sulphur content in the coke rose alarmingly. Improved washing of the coal has brought the sulphur figure down to a more reasonable figure, but there are unquestionable advantages in reducing the sulphur in metallurgical coke still further. It has been calculated by the American fuel technologist, A. R. Powell, that the elimination of 0·25% of sulphur from a coke would enhance the value of the coke by no less than one dollar (4 shillings) per ton.

The elimination of sulphur from domestic coal and coke is no less important; it is unquestionable that the greater part of the damage due to smoke results directly from its sulphur content. Smoke composed of tar and soot may be unsightly and may screen radiation, but bearing in mind that tar is a preservative paint, it is difficult to discover how damage to buildings can be caused unless sulphur acids are present. But how to prevent the bulk of the sulphur that will always be contained in coal from entering the atmosphere is a question easier propounded than solved.

It may be that in the course of time methods of removal of sulphur dioxide from chimney gases will be developed so simple as to enable them to be applied to all but the smallest industrial chimneys. It is conceivable that the recovery methods will produce sulphuric acid direct or some other form of sulphur product which will enable the removal to be actually profitable. It is more likely that the damage due to sulphur will be realized by the nation in general and that in the thickly populated areas the removal of SO_2 will be made compulsory upon every manufacturer just as is the removal of H_2S to-day by the gas manufacturer. Even when this is done, however—and it must be confessed that the state of knowledge of the subject of sulphur removal no less than the sluggishness of the public conscience does not hold out much likelihood of any imminent action—the problem of the domestic chimney remains. No doubt the substitution of gas for coal is the ideal solution, but so long as the present relative cost and income figures remain operative, solid fuel will be required. To remove the sulphur from coal is impossible by any known process, but it is possible, even though as yet uneconomic to remove sulphur from coke.

Recognized from Early Times.

The desirability for removal of sulphur from coke had been recognized from early times, though primarily for reasons connected with the operation of the blast furnace. The well-known coking expert (and coal-owner) of the period, A. L. Steavenson, writes in 1862 that "there are patents innumerable for removing sulphur from the coke," and as an example of the methods used a description may be quoted of an early quenching process that was in operation at Selly Oak Nail Works whereby "by a simple arrangement of pipes below, jets of steam are disseminated through the entire burning mass, by which means the fire is extinguished so as to admit of rapid removal of the cokes, and owing to its affinity for steam, *if any sulphur remains it will be evolved and carried off with the steam.*" While some of the patents granted at that time were capable of removing a portion of the sulphur the majority were entirely useless; be that as it may, the fact remains that none of the methods passed into common practice. Twenty years ago, the late Prof. O'Shea was fond of introducing into his lectures to students an account of experiments he had undertaken in a coke oven, whereby he attempted to eliminate the sulphur from the coke by introducing hydrochloric acid into the oven, hoping that the sulphur would be present as metallic sulphides which would be acted upon by the acid vapours giving off their sulphur as H_2S. Actually the sulphur content of the coke was slightly increased, because in order to give the experiments the possibility of commercialization, impure HCl was used, which itself contained considerable quantities of sulphur. That was the Professor's explanation, though whether the experimental difficulties of sampling from a charge of five tons of coke in which the sulphur was not uniformly distributed had not more to do with it is open to question.

Modern work on sulphur elimination may be said to have commenced with the researches of A. R. Powell in America, who first devised analytical methods for determining the forms in which sulphur is present in coal and coke and the proportions of the several forms. Sulphur is contained in coal in three forms, and in the coal as it exists in the mine for the most part in two forms only. These two are iron disulphide, pyrites or marcasite, and organic sulphur. When the coal has been allowed to oxidize for even quite a short while, sulphates appear, but in most unoxidized coals they are present in but small quantities. Powell's methods of analysis are given here for the information of any who may desire to undertake work upon this interesting subject and who may not have access to the original Papers.

For the estimation of sulphates, 5 grammes of the coal are allowed to stand at a temperature of 60° C. for 40 hours in 300 c.c. of 3% HCl. The sulphates are thereby dissolved out and may be estimated in the filtrate in the usual way. One gramme of the residue from the sulphate determination is taken for the estimation of pyrites; the coal is allowed to stand for 24 hours at room temperature with 80 c.c. of dilute nitric acid (1 : 3). The pyrites is oxidized and after removal of the coal the filtrate is evaporated to dryness, taken up with HCl, and sulphur estimated in the clear liquid in the usual way. The organic sulphur may be taken as the difference between the sulphur present as sulphates *plus* pyrites and that determined as "total sulphur." Alternatively the organic sulphur may be directly determined and separated into two forms, resinic and humic. For the humic sulphur that residue from the pyritic sulphur determination is used. This coal is allowed to stand for several hours in 25 c.c. of ammonia (density 0·90) and after dilution is filtered; the filtrate is evaporated to dryness, the solid residue from the evaporation is fused with sodium peroxide prior to estimation of sulphur in the usual way. For the resinic sulphur, 0·5 gramme of coal is extracted with phenol by boiling under a reflux condenser for 20 hours. The residue is filtered off through a Gooch crucible, the coal being washed into the crucible with alcohol or ether; after drying the residue a sulphur determination is carried out upon it. The difference between this figure and the total sulphur is the resinic sulphur.

Proportions of Sulphur-Bearing Constituents.

The relative proportions in which these sulphur-bearing constituents are present in coal may vary within wide limits. As illustration, it is sufficient here to summarize the figures for 10 American coals published by Yancey and Fraser in 1921 (J.Ind. Eng. Chem., 13, 36); sulphates were not determined, and of the organic and pyritic sulphur, in five of the coals the proportion of organic sulphur was between 40 and 60% of the whole; of the other five coals the proportion of organic sulphur was as low as 20% or as high as 84%. Other examples of a complete analysis will be given when considering Powell's figures for the behaviour of the sulphur compounds upon carbonization.

The first stage in sulphur removal must take place at the colliery washery. Unfortunately many coals cannot be adequately freed from sulphur on account of the form in which it is present. Sulphur present as organic sulphur obviously cannot be removed in the washer; where a coal contains but 20% of this form as in the example just quoted, a very great deal is possible; but when the proportion approaches 80%, washing becomes almost ineffective. Even with the coals containing the greater portion of their sulphur content in the form of pyrites, much will depend upon the form of the pyrites. In some coals it is nodular and readily removed; in others it is disseminated through the coal in a feathery form, running through the solid lump and not easily detachable. In such coals the

only possibility of sulphur reduction is a preliminary fine crushing followed by froth flotation or other form of washing suitable for the treatment of fine coal.

When all possible has been done at the washery there still remains a residuum, large or small, that defies washery treatment. How this sulphur can be prevented from reaching the atmosphere is the problem Nature has set us to solve. Where raw coal is burnt the problem is ever more difficult than when the coal is to be carbonized. It is difficult to imagine any form of treatment that would render the sulphur innocuous in lump house coal, for example. On the other hand, we may believe that by the time the sulphur problem has been tackled thoroughly, raw coal will not be burnt in many domestic grates. Raw coal will be burnt industrially, but the problem does not concern us in the present article; it will suffice to say that the solution may conceivably lie in the direction of recovery of the SO_2 from the chimney gases as foreshadowed earlier in this article. It may lie—and so also may the problem of the sulphur in coke—in some method of fixing the sulphur so that it is retained in the ash. F. Foerster and W. Geisler (Z. Angew. Chem. 35, pp. 193-8), for example, state that by adding lime to the coal ash it is possible to burn cokes containing up to 2·5% of sulphur without evolution of SO_2. T. Trifonov and E. Rasheva-Trifonov find that by carbonizing coals mixed with dolomite most of the sulphur is retained in the ash of the coke after combustion, the retention being due to the protective action of the calcium carbonate upon the magnesium sulphate formed. Magnesium carbonate alone does not appreciably retain sulphur upon combustion. In this connection it is interesting to notice that N. N. Chaterjee (Quart. J. Geol. Min. Met. Soc., India—1932) maintains that the present methods of determining total sulphur are not the best suited to giving information of real value, but that the figure which should be determined is the amount of sulphur which escapes when the coal or coke is burnt. Very little work appears to have been done upon this aspect of the subject, and an attempt to discover a method of fixing the sulphur without adding materially to the ash content might prove valuable, especially as it could be readily applied to coke.

The fixation of the sulphur in the ash remaining after combustion may prove the ideal method of solving the sulphur problem in coke used in the domestic grate; it may not be satisfactory for coke used industrially. It becomes necessary, therefore, to ascertain the behaviour of the sulphur compounds in coal during carbonization and to discover in what form sulphur exists in coke. For this purpose two series of results obtained by A. R. Powell upon American coals may be taken as the basis. The coals used comprised a Tennessee coal high in sulphur, containing about equal quantities of pyritic and of organic sulphur and also a fair percentage of sulphate sulphur, arising from oxidation; and a Pocahontas coal of low sulphur content in which most of the sulphur was present in the organic form. The distribution of the sulphur after carbonization at various temperatures is given in the following table:

Tennessee Coal.

Volatile matter, 39%; ash, 7·8%; total sulphur, 4·25%.

Temp. of Carb., °C.	Original Coal.	300.	400.	500.	600.	1,000.
Pyritic sulphur	1·75	1·75	1·42	0·31	0·0	0·0
Sulphate sulphur	0·71	0·55	0·41	0·01	0·01	0·0
Organic sulphur	1·79	1·63	1·51	1·70	1·7	1·81
Sulphide sulphur	0·0	0·13	0·44	0·93	0·82	0·84
Sulphur as H_2S	0·0	0·19	0·39	1·20	1·39	1·44
Sulphur in tar	0·0	0·0	0·05	0·10	0·16	0·16
Sulphur as CS_2	0·0	0·0	0·0	0·0	0·0	0·0

Pocahontas Coal.

Volatile matter, 22·9%; ash, 6·25%; total sulphur, 0·56%.

Temp. of Carb., °C.	Original Coal.	300.	400.	500.	600.	1,000.
Pyritic sulphur	0·08	0·07	0·09	0·01	0·0	0·0
Sulphate sulphur	0·01	0·02	0·02	0·0	0·0	0·0
Organic sulphur	0·47	0·47	0·44	0·43	0·35	0·27
Sulphide sulphur	0·0	0·0	0·0	0·04	0·05	0·09
Sulphur as H_2S	0·0	0·0	0·01	0·06	0·13	0·17
Sulphur in tar	0·0	0·0	0·0	0·02	0·03	0·03
Sulphur as CS_2	0·0	0·0	0·0	0·0	0·0	0·0

From an analysis of these reactions it is clear that five primary reactions occur which affect the sulphur in the coal:

(1) The pyrites decomposes completely and disappears shortly after a temperature of 500° C. is reached. This reaction begins at 300° C. and reaches a maximum at temperatures between 400° and 500° C. Presumably if the coal were to be maintained at 300° C. for an indefinite period of time the reaction would go to completion at that temperature; the quickening between 400° and 500° C. is the normal effect of increased temperatures on the velocity of the chemical reaction. The decomposition product of the pyrites is pyrrhotite. Pyrrhotite is a body having the general formula Fe_nS_{n+1}; it is variable in composition, ranging chiefly from Fe_7S_8 to $Fe_{11}S_{12}$.

(2) The pyrrhotite does not completely decompose, and in many instances is but slightly affected. A reaction into which this constituent enters is the combination of the sulphur with carbon, but since most of this sulphur appears to be retained in the carbon of the coke there is but little reduction in the sulphur content of the coke. The pyrrhotite-coke reaction is most active above 500° C. The formation of carbon disulphide appears to take place only when the sulphur has been volatilized before coming into contact with the carbon.

(3) Any sulphates that may be present are reduced to sulphides. The reaction, which is complete at 600° C. and virtually complete at 500° C., does not cause reduction in the sulphur content of the coke.

(4) The organic sulphur compounds do not readily liberate their sulphur. In the high-sulphur coal of which the carbonizing figures have just been given the organic sulphur falls slightly up to a temperature of 400° C. and then rises again progressively. When there is but little sulphur in the coal the amount retained as organic sulphur decreases continuously. It may be suggested that the determined figures are the resultant of two reactions, one being the decomposition of the organic sulphur compounds with liberation of a little sulphur, and the other the absorption of sulphur by the coke in some different form from that already existing in the coal or its decomposition product. Powell believes that some 25% to 33% of the organic sulphur decomposes, for the most part below 500° C. The net result of the reactions into which the organic sulphur interacts without the intervention of hydrogen, appears likely to increase the quantity present in this form rather than to decrease it.

(5) Some of the organic sulphur which is evolved is found in the tar in the form of organic sulphur compounds.

The organic sulphur compounds not accounted for by these reactions is profoundly changed in character between 400° and 500° C. and shows none of the properties of the original coal sulphur.

In addition to these primary reactions, which cause little loss of sulphur from the coke with the sole exception of the elimination of one-half of the pyritic sulphur, there occur certain secondary reactions having a more important bearing on the problem of desulphurization. The direct reaction of sulphur or H_2S on carbon is responsible for the formation of CS_2 which is never found as a primary product, but the sulphur content of the coke is not affected thereby. The important secondary reactions are all due to hydrogen. The hydrogen travelling through the hot coke removes sulphur at high temperatures, the rate of removal being the more rapid the higher the temperature. In absence of hydrogen, as has been shown, the evolution of sulphur practically ceases at 600° C. It is only the effect upon the organic sulphur that is specially significant in the action of hydrogen under ordinary carbonizing conditions. The effect of hydrogen upon pyrites is to speed up the normal decomposition and to render it practically complete at 500° C.; without hydrogen the reaction would be complete at the end of the carbonizing period.

The decomposition of the organic sulphur, or its derivative "carbon-sulphur," to form H_2S is enormously increased in presence of hydrogen at temperatures above 500° C. and the coke is thus partly desulphurized. The reaction is rapid, but its possible practical application is limited because it is an equilibrium reaction. In one experiment it was recorded that hydrogen was in equilibrium with coke containing 1·2% of sulphur when the gas contained 0·25 lb. per 1,000 cu.ft. at 900° C. These figures would appear to show that a large volume of hydrogen is necessary to desulphurize coke. The normal passage of hydrogen over the coke during the later period of the carbonizing operation is quite insufficient. Recirculation of unpurified gases containing sulphur in excess of saturation point actually puts sulphur back into the coke, so that if recirculation should be attempted the gases used must be previously purified from sulphur. Nevertheless, that something can be done by contact with hydrogen is shown

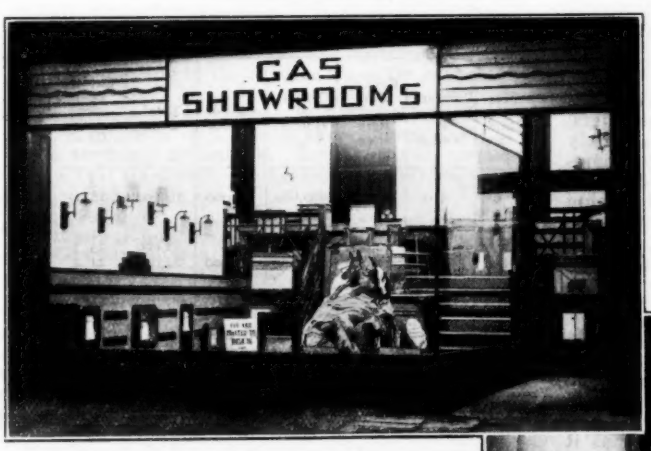
by the patent of Prof. Wheeler and Jolly who added anthracite—a source of hydrogen at higher temperatures—to the charge.

The general conclusion from these researches is that about half the pyritic sulphur and such of the organic sulphur as the hydrogen can liberate is eliminated from coke during the process of carbonization. The result, as is well known, is to leave quite large amounts, sometimes very large amounts, of sulphur in the coke. Nothing in these results gives any hope of reducing substantially the sulphur now left in coke, with the possible exception of the hydrogen reaction. Some experimenters have tried other reactions now customarily taking place in the retort, primarily by addition of inorganic substances. Additions of iron to the coking coal have been tried, though it is difficult to see on what basis hopes were entertained. Only when the treated coke was subsequently submitted to the action of hydrogen was any of the sulphur removed. Under these conditions iron assists the reaction. It seems possible that some substance such as a manganese salt might be found which would assist the hydrogen reaction in the retort. Manganese is used for the purpose of sulphur removal in steel works. Actually Schulte (German patent 534,721 of 1930) has patented the use for this purpose of small quantities of metallic catalysts, consisting mainly of manganese or chromium compounds. There seems no reason to suppose that this process has ever passed the experimental stage.

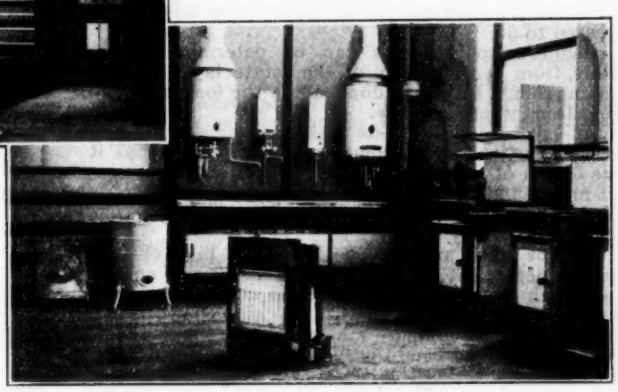
The conclusion must be reached, therefore, that in the present state of our knowledge the hydrogen reaction is the only possible one. Several experimenters have investigated this reaction, among the chief of these being Dr. Monkhouse and Prof. Cobb. The work of these experimenters is too well known to the Gas Industry to require more than the briefest summary here. They investigated the expulsion of sulphur from cokes having various characteristics—a semi-coke made at 500° C.; a medium coke made at 800° C.; and a hard coke made at 1,000° C. As was to be expected, the differences in initial sulphur content between cokes made at these three temperatures was small, 56·4% of the sulphur initially present in the coal appearing in the semi-coke, and 50·1% in the medium coke; neither of these cokes lost more than negligible quantities of sulphur when heated in a current of nitrogen to 1,000° C. On heating the soft (low-temperature) coke to 800° C. in hydrogen, H_2S was evolved steadily up to 800° C., when the evolution diminished. This reaction may be the resultant of the speeding-up of the decomposition of the pyrites and of the action of hydrogen on the organic sulphur compounds. Whatever it may be, the reaction is not one which proceeds readily to completion at 800° C., for after heating even for 40 hours, hydrogen was still being evolved. An observation which does not appear to have been made by Powell is that on further raising the temperature, at 900° C. the evolution of H_2S suddenly accelerated as if some sulphur compound hitherto resistant had been attacked. When the treatment was stopped, the temperature being 1,000° C., some 93·8% of the sulphur had been obtained as H_2S. For the particular coke examined, the sulphur could be removed by treatment in the retort with gases containing hydrogen, but the time and expense involved makes the process impossible commercially. As an example of the time required the following figures may be quoted obtained by R. D. Snow (Ind. Eng. Chem., 24,903-9—year 1932). In each instance the sample of coke was maintained at the temperature stated in a stream of the gas named, for four hours.

Temperature. ° C.	Gas.	Sulphur Eliminated. %.
1,000	N_2, CO_2, CO, CH_4, C_2H_4	50-60
	Ammonia	81
	Hydrogen	87
	Water gas	76
800	Steam	84
	Water gas with HCl	72·5
	Rapid carbonization in atmosphere of hydrogen	59
	Partial removal of pyritic sulphur by oxidation and leaching followed by carbonization	93

The difficulty, therefore, is not to find a workable process but to find a commercially feasible process. It may be that some extension to our knowledge may discover a reagent (" catalyst " if the use of our modern abracadabra may be pardoned) which will release the sulphur under normal conditions of carbonization or after short treatment with hydrogen, but it seems at present more probable that likeliest method of attack is the somewhat negative one of rendering the sulphur innocuous by finding means to retain it in the coke upon combustion.



New Showrooms at Ossett



Ossett's new gas showrooms were opened recently by the Mayoress in the presence of members of the Corporation and adjoining Councils, after which a dinner was held at the Town Hall. Alderman G. F. Wilson, in proposing the health of the Chairman of the Gas Committee, remarked that Mr. A. E. Mottram (the Engineer and Manager) and his Committee had fought electrical competition very well indeed, as shown by the fact that whereas the gas sold in 1913-14 totalled 133 million cu.ft., in 1934-35 the figure was 145 millions. It was evident that they were holding their own, and he was confident that the Undertaking was in good hands. Our photographs show an exterior view of the new premises at night, together with a section of the appliance display within, and indicate how well a small showroom can be arranged to provide a representative display of all the latest domestic gas appliances.

FACTS AND FIGURES ON
Gas Distribution

by
J. W. DENTON,
Distribution Superintendent to the Torquay and Paignton Gas Company

A Paper read before the Western Junior Gas Association on the occasion of their visit to the Works and Showrooms of the Torquay and Paignton Gas Company on Saturday, Dec. 14.

In considering extensions to the distribution systems of an undertaking, several factors must be given consideration. I do not propose to offer any suggestions for the determination of the economical limit to which extensions should be carried, having respect to sales, capital, and revenue accounts, but assuming the development is to go forward, to outline the methods adopted with a view to ensuring efficient and economical execution of the mainlaying. The points to which consideration must be given are:

(*a*) Density of building, possible consumers, and possible extensions.
(*b*) Consumption per consumer on peak loads.
(*c*) Type of main, high or low-pressure, with provision in the case of a long main for storage capacity at the terminus.
(*d*) A suitable point for the extensions to commence and the effect on the existing system.
(*e*) Route, with respect to geological survey, traffic conditions, and road reinstatement charges.

I propose to deal now with these points in detail.

Density of Building.

It is usually possible by conference with the local authorities, to estimate quite accurately the maximum number of houses which can be built on a certain estate or area in which development is commencing, and, in designing the size of pipe-line, consideration must be given to this aspect. If the main under consideration is running to the limits of the statutory area of the Company, and no further extensions of area can be anticipated, an accurate forecast can be made of the maximum load expected, taking into consideration the maximum density per acre, imposed by the Town Planning Committees, and the corresponding main size formulated accordingly. The distribution plan for the whole area should be segmented and the design developed so that extensions can be made with full knowledge of the load each segment is expected to carry, and, as far as possible, these segments linked by mains in ring formation.

Consumption per Consumer.

The maximum hourly output recorded at the Works is 350,000 cu.ft., and averaging this over the 19,000 consumers, the maximum average consumption is approximately 18 cu.ft. per hour per consumer. The maximum consumption per consumer per day has been averaged at 135 cu.ft. It is advisable to use a safety factor of 4 when designing the main, to allow for inevitable depreciation in the carrying capacity of the main, loss of pressure at the inlet to section, and the increase in the peak load consumption per consumer. In districts where the industrial use of gas is even remotely possible this factor might, with advantage, be increased to 6.

The smaller supply mains can be determined quite accurately from consideration of the estate lay-outs, and these mains should be laid in duplicate in the footpaths and with ring feeds where possible.

This laying of small duplicate mains can be shown to be economical, particularly in concrete roads, reducing as it does the length of the wrought iron supplies and their consequent maintenance and reinstatement repair charges.

Type of Main.

The type of trunk main to be laid—*i.e.*, high or low-pressure—is dependent upon several considerations, not the least of which is the present congested conditions of old established roadways; in a number of cases choice is not practicable and high-pressure mains must be employed to meet the underground conditions. Where it is not practicable to lay large mains the most economical installation should be carried out with relation to capital costs, capital charges, and compressing costs, and generally speaking a medium-sized high-pressure main with compressors working at 5 lb. per sq.in. would appear a better proposition than a smaller main working at higher pressures.

On long mains, consideration must be given to the desirability of providing storage capacity either low or high-pressure, with a view to decreasing the delivery required to meet the hourly peak demands, as against the daily peak demands. The calculations for these high-pressure mains are carried out by the use of Unwin's Formula and Reynold's Criterion, and the figures given below are those which were used in connection with an extension proposed by our Company.

At Barton Cross, St. Marychurch, the point in the high-pressure mains selected for the commencement of this supply main, there is available a pressure of 3·4 lb. per sq.in., with a delivery of 70,000 cu.ft. per hour, which is adequate for the supplies of St. Marychurch and Kingskerswell only. This high-pressure gas could then be utilized during the short period of the peak load consumption only, for a high-pressure supply on the contemplated extension. On night or light load periods it could thus be utilized for the refilling of the holder.

Table of Deliveries.

Size of Main, In.	Inlet Pressure, Lb. per Sq.In.	Outlet Pressure, In.	Delivery at Terminus, Cu.Ft. per Hour.	Delivery at Terminus. Cu Ft. per Day.	Maximum Consumption per Consumer perHour. Cu.Ft. 8.F.=4.	Maximum Consumption per Consumer per Day. Cu.Ft. 8 F.=4.	Maximum Number Consumers if no Storage.	Maximum Number Consumers with Holder.
6	3·4	10	20,270	486 480	72	540	281	900
10	2·6	10	65,000	1,560,000	72	540	903	2,888
10	3·4	10	77,300	1,855,000	72	540	1,074	3,436

The number of consumers contemplated with respect to the density of building in this area is approximately 900. The choice then seems to lie with the existing compressing plant, between a 6-in. high-pressure main, with storage at the terminus, or a 10-in. high-pressure main, with distribution through reducing governors.

Estimated Costs of Proposals.

Size of Main. In	Pressure Required at Works.	Cost of Main, including Reinstatement.	Capacity of Holder. Cu.Ft.	Cost of Holder.	Total Cost.	Capital Costs per Existing Consumer.	Remarks.
		£		£	£	£	
6	5·0	6,300	500,000	10,000	16,300	18·1	Compression costs also slightly higher
10	4·2	12,000			12,000	13·3	
10	4·2	12,000	500,000	10,000	22,000	24·4	

From this table it will be observed that the 10-in. main with no holder is a more economical proposition than the 6-in. with holder, and in addition gives further flexibility in that, should unforeseen circumstances make it necessary, storage capacity can be arranged which will increase the possible number of consumers supplied by nearly 300%, with only a total increase in capital charge of 33%.

Point of Connection and Geological Survey.

The most suitable point for tapping an existing system of trunk mains usually is easily determined, but in calculating gas flows through the proposed mains, close consideration must be given to the effect of the new demands to existing systems. Pressures must be checked along the existing trunk mains, and flow calculations carried out backwards to the source of supply. The use of Pitot tubes in the investigation of the existing flow conditions is a great asset in this connection to obtain accuracy.

Particularly in the area of supply of this Company is it necessary closely to study the geological survey before deciding the route of the main, with a view to eliminating rock breaking charges. Torquay is peculiar in its natural formation, and changes in the sub-soil are frequent. The geological survey map has been found so far remarkably

accurate, and even if the difficulties cannot be avoided, provision can be made to meet them. Recently, when this Company carried out an extension of mains to the village of Stoke Gabriel, the geological survey assisted materially in the arrangement of the work. The 3,700 yards of 10-in. diameter cast iron trunk main was completed in less than six weeks' time, and was laid to avoid, wherever possible, the rock *en route*. By the alteration of route to suit geological conditions, revealed by the survey map, it was possible to reduce the amount of gelignite used to approximately 1,000 lb., instead of an estimated amount of one ton, and in addition to save considerable time and labour.

Modern Traffic Conditions.

The recent Road Traffic Act would not appear to have affected the statutory powers of gas undertakings, but certain conditions obtain which makes consideration of the changes necessary.

'Bus routes are approved by the Ministry of Transport, and the operating companies are obliged to notify the Ministry of any change made in the routes. Consequently before any road can be closed to traffic, the usual notice should be served on the Surveyor responsible, and, in addition, the 'bus company consulted with a view to their arranging alternative routes approved by the Ministry of Transport.

Mainlaying.

Points occasionally arise in the actual operation of mainlaying which present a much more general problem than the usual difficulties encountered daily.

Changing conditions have made it necessary to study more closely the effect of loads on the main instead of the life of the main against corrosion. I do not propose attempting, in a general Paper as this is, to discuss the relative merits of cast-iron and steel, or to bring forward in detail the advancement made in asbestos pressure pipe. I should, however, like to point out that the need for a pipe stronger than the sand cast-pipe is imperative with modern traffic loads and speeds, and in this connection great advancement has been made in the manufacture of cast-iron pipes by centrifugal casting. Various methods have been adopted by the manufacturers:

(*a*) The sand-spun pipe which, by virtue of its manufacture by centrifugal action is claimed to be of closer texture than the normal type of pipe, and because the outside mould used in the spinning is of sand, is free of any suggestion of sudden cooling and attendant brittleness. Defects such as sand holes, blow holes, and cold shot are also eliminated.

(*b*) The chilled pipe which is spun in a mould cooled by water and later annealed in a furnace at 900° C. possesses distinct advantages. It is claimed that the chill traps the carbon in the metal in a very fine form, which gives hardness and brittleness. Consequent annealing in the furnace turns the carbon from white to grey, giving greater ductility, and microphotographs show that in a chilled and annealed pipe the graphite is in a fine granular form and not in close sectional disposition. Actual tests on specimens show that the tensile strength of longitudinal sections taken from pipes are as follows:

Cast-iron	10·7 tons per sq.in.
Centrifugally-spun	14·0 ,, ,,
Centrifugally - spun chilled and annealed	16·0 ,, ,,

Brinnell tests on a section cut from a chilled and annealed pipe give:

Outer surface hardness	185
Centre section hardness	168
Inner surface hardness	143

(*c*) Methods of controlling chill are now being used in the casting of pipes by a combination of processes. A thin coating of powdered ferro-silicon is mechanically applied to the surface of the revolving mould before the metal is introduced. This method of casting, followed by normalizing heat treatment, produces a pipe which it is claimed is free from chill and possesses valuable structures throughout the thickness of the metal, together with high ductile and tensile strength hitherto unobtainable in combination.

Steel Mainlaying.

Steel mains, on account of their strength and freedom from fracture, are preferred by some undertakings. They are admirably suited to mainlaying on sections where their length may be utilized to full advantage, the consequent saving in jointing and excavation being a consideration, and a saving in transport charges is an additional attraction. Nevertheless the fear of corrosion in steel mains, both internally and externally, is a factor which tends to make their use less universal. Internal corrosion is in evidence when high-pressure governors fitted on a steel main are overhauled, and serious pitting is often found at the joints when mains are opened. Great care with the wrapping must be taken when steel mainlaying, the pipes should be ordered with a double protective wrapping and oiled internally, and the closest supervision given to the handling and patching of the pipes and the wrapping of joints.

Mains have been opened after only six years' life where the protective wrapping around the joints has been ineffective and corrosion has commenced. This has been caused by the joints not being closely wrapped, voids being left just in front of the circumferential face of the lead. The wrapping must be soaked in the prescribed protective coating before application and tightly wrapped around the joint.

On the other hand, recently a section was cut from a steel main laid eighteen years ago in a stony but good track, and while the wrapping was perished it remained intact, and considerable protective bitumen was observed below the wrapping. Corrosion had not taken place in any way to affect the strength or soundness of the main.

Natural electrolytic action, which has been attributed as being one cause of corrosion in steel, it is claimed has been reduced by copper bonding the steel mains at intervals of approximately half a mile to wrought iron earth rods sunk into the subsoil to the depth of water. Upon examination later, it has been considered that the main was affected by corrosion on these sections and deterioration had taken place in the earth rods.

When a long main has to be laid, and it is fairly certain that no cross obstructions will interfere, a steel main laid with welded joints is a very economical way of carrying out the work. With inserted welded joints the up-end method of mainlaying may be used, each length being lowered into the trench successively as the work proceeds. This allows the jointer to work above the ground or standing in the trench, and besides improving his workmanship in reduced time, eliminates joint holes except very shallow ones for testing and subsequent wrapping and pitching. A main laid in this way might be allowed to be sprung around curves, but with other than welded joints a steel main must only be laid when curved with a permanent sett.

It is not easy to bend even small steel mains without kinking, but by means of a coke brazier and compressed air large sized mains may be easily set. The coke brazier used by this Company for this purpose is 5 ft. long by 2 ft. wide and with a fire depth of approximately 18 in., mounted on small wheels for easy handling. Three 1-in. tees are arranged on a supply below the lower bars, and this supply is connected when required to the Broom Wade portable air compressor. Air at 80 lb. per sq.in. is blown through the fire, and by this means 10-in. pipes have been set to template bends with certainty and ease.

Asbestos Cement Pipes.

Asbestos cement pressure pipes are now being used by some undertakings; laboratory tests show them to be in most ways suitable for gas mains, but the type of joint which must be used to form a socket, which may be either cast-iron or asbestos cement, has not yet been approved sufficiently to give confidence for use by this Company. The pipes are made to socket into any cast-iron special faucet, but an open socket to withstand the normal caulking load, which is a ring stress of two tons per square inch, does not appear practicable in cement.

Jointing.

Improvements in the type of joints for cast-iron mains are being attempted, it being recognized that in view of the increasing amount of traffic vibration the older type of rigid pipe joints are in many instances no longer satisfactory.

Consideration is being given to the use of cast-iron pipes with no bend on the spigot, and it is claimed that a main laid with joints so made with lead wool or run lead is less rigid and more suitable for the vibratory loads of the present day. In the unfortunate event of lateral movement of the pipes, causing drawing of the joints, no extrusion of the lead is caused, and the joint has a better chance of remaining gas tight. It would be necessary, however, to use lead or tarred yarn for the first ring in the back of the sockets to prevent intrusion of the jointing material into the pipe when a spigot with no bead is used.

Another new method of jointing is the recently introduced Stanton Wilson joint. In this joint a ring of special rubber tipped with lead on the apex where it is in contact with gas is held in position by means of a cast-iron collar. The collar is tightened mechanically by a rack and pinion attachment, which gives a lateral tightening movement of the joint by means of helical lugs engaging in the specially

designed collar. This rubber joint fulfils the conditions necessary to the long life of the rubber—namely, that it should remain damp, be kept under compression, and be protected from light and air. The resulting joint is claimed to withstand the effects of ground subsidence and modern heavy traffic.

The actual cost of the joint is slightly more than the normal lead open socket joint, even considering the saving in the cost of jointing. Consideration must be given, however, to the saving effected by the speed of mainlaying, which, by being increased, may reduce the overhead mainlaying expenses to which reference will be made later. Two labourers may be expected to make at least fifteen 4-in. joints per hour in the trench.

Distortion may be carried out even on high-pressure mains with these joints to the extent of five degrees with no leakage, and a bend of radius twelve times the length of the pipe can be negotiated with no specials. In the event of a broken pipe, two Stanton Wilson joints will remarry on 18-ft. pipes with no double collar, and three 12-ft. pipes with equal facility.

Steel Joints.

For low-pressure steel joints the rigid long-sleeve joint is most commonly used, the joints being made completely with lead wool or with lead wool and yarn, using special thin caulking tools and preferably a pneumatic hammer. The approximate quantities of lead wool and yarn for rigid joints are as follows:

In.	Lead Wool. Lb.	Yarn Oz.
3	3·5	6
4	4·25	8
5	5·5	10
6	6·5½	12
7	8·0	14
8	9·5	17
9	11·0	19·5
10	13·25	23

When laying high-pressure mains the ease of setting up and preparing for welding an inserted welded joint is, in my opinion, an advantage which far outweighs the saving effected in tube length when using butt welded joints. Actually the tubes are sold by the manufacturers in effective lengths, and the reduction in cost of 2½% for the elimination of the short faucet required on an inserted welded joint does not usually repay the extra work involved in setting up the butt end for the welder. In addition, the care and supervision which has to be given to prevent intrusion of welded fingers into the main is not required with inserted welded joints.

Overhead Charges of Mainlaying Operations.

The overheads of ganger, flagman, watchmen, fuel, lighting, and wasting of jointers' time can be eliminated by careful balance of the personnel, and thus by accurate arrangement of the gangs considerable reduction made in the costs of mainlaying.

Costs of cast-iron mainlaying (Table A) under very good conditions have been obtained, and by analysis of these costs the gangs have been proportioned as in Table B. The prices given per yard are selected examples of good straightforward mainlaying, and for comparison Table C shows the average cost of mainlaying per yard over normal conditions. It is not claimed that these figures may be taken as indicating the best combination of skilled and unskilled labour in mainlaying, as conditions vary so considerably, but they will serve to show the methods we are adopting to reduce wastage. The haulage on mainlaying is very closely watched, and Servis Recorders are fitted on all delivery vans and lorries so that a check is obtained on running and standing time.

The haulage of deads or excavated earth from the job should be given very careful attention. By estimation of the quantity which has to be removed, it is possible to reduce haulage to a minimum and yet effectively keep sections of the mainlaying operations free from obstructions caused by deads and also prevent interference with traffic.

TABLE A.—*Approximate Costs of Jointing and Laying Spun Pipes, Class B.*

[18 Ft. Lengths, Excluding Live Connections, in Ordinary Tarmac Roads, in Ground Free from Rock, Hard Shale, Water, or Running Sand, at 2 Ft. 6 In. Cover, Excluding Permanent Reinstatement.]

—	Size of Main	4-In.	6-In.	8-In.	10-In.	12-In.	20-In.	
	Rate of Progress (Yards per Week)	500	400	300	240	200	100	
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
1.	Breaking up surface, per linear yard	0 2·5	0 3·0	0 4·0	0 5·0	0 6·0	1 0	
2.	Excavation	0 9·3	0 11·0	1 1·0	1 3·6	1 7·0	3 0	Includes timbering
3.	Filling and ramming	0 3·1	0 3·7	0 4·3	0 5·2	0 6·5	0 10·0	
4.	Carting surplus soil	0 2·0	0 3·5	0 5·0	0 7·0	0 9·5	1 4·0	Includes labour loading
5.	Carting pipes to site and unloading	0 1·2	0 2·0	0 3·0	0 4·0	0 5·0	0 11·0	
6.	Cutting joint holes	0 0·5	0 0·5	0 0·7	0 1·0	0 1·5	0 3·0	
7.	Levelling trench bottom and handling pipes into trench ready for jointing	0 2·4	0 3·0	0 4 0	0 6·0	0 8·0	1 5·0	
8.	Jointing—							
	(*a*) Materials, including firing	0 2·0	0 3·0	0 4·0	0 5·0	0 6·0	1 0	Includes jointing on normal specials
	(*b*) Labour, including testing	0 2·5	0 2·9	0 3·5	0 4·5	0 5·5	2 3·0	
9.	Watching, lighting, and fencing	0 1·3	0 1·6	0 2·2	0 2·7	0 3·5	0 10·0	
10.	Repairs and maintenance of tools	0 0·5	0 0·5	0 0·5	0 0·5	0 0·5	0 1·0	
11.	Temporary reinstatements and maintenance of track	0 1·5	0 1·5	0 1·5	0 2·0	0 2·5	0 4·0	
12.	Supervision	0 3·0	0 3·6	0 4·8	0 6·0	0 7·5	1 3·0	
13.	Third Party Insurance, Workmen's Compensation Act Insurance, contingencies	0 1·0	0 1·2	0 3·0	0 5·0	0 8·0	2 0	
	Totals	2 8·8	3 5·0	4 5·5	5 9·5	7 5·0	16 6·0	

TABLE B.—*Average Daily Allocation of Men.*

—	Size of Main :— Yards Laid per Day :—	4-In. 100.	6-In. 80.	8-In. 60.	10-In. 48.	12-In. 40.	20-In. 20.
1	Breaking up surface	2 men, or 1 pneumatic pick	2 men	2 men	2 men	2 men	2 men
2	Excavation	8 men	8 men	7 men	7 men	7 men	6 men
3	Filling and ramming	3 men	3 men	2 men	2 men	2 men	2 men
4	Carting surplus soil	5½ hours lorry and man	8 hours lorry and man	8 hours lorry and man	9½ hours lorry and man	10½ hours lorry and man	9 hours lorry and man
5	Carting pipes to site and unloading on track	As required	As required	As required	As required	As required	As required
6	Cutting joint holes	2 men	2 men	2 men	3 men	3 men	3 men
7	Levelling trench bottom and handling pipes into trench ready for jointing	2 men	2 men	2 men	3 men	3 men	3 men
8	Jointing: (*a*) Labour	2 men	2 men	2 men	2 men	2 men	4 men
9	Watching, lighting, and fencing	As required	As required	As required	As required	As required	As required
10	Repairs and maintenance of tools	As required	As required	As required	As required	As required	As required
11	Temporary reinstatement and maintenance of track	1 man	1 man	1 man	1 man	2 men	2 men
12	Supervision	Ganger	Ganger	Ganger	Ganger	Ganger and supervisor	Ganger and supervisor

Damage to Other Services.

When mainlaying, care must be taken to prevent damage to the supplies and services of other undertakings. This cannot be too strongly emphasized, as what damage might to a gas undertaking appear trivial, is often to the other public suppliers very serious. The following methods, if adopted, will help towards elimination of accidental damage:

Mark all water pipes, cables, and ducts from the information given by the authority concerned, and by observation of boxes, valve covers, &c.

Examine all exposed cables after the workmen have completed excavation, and again before backfilling, and report any scars to the electrical authority.

Prohibit the use of water-pipes, drain pipes, or cables as a means of climbing out of the excavations.

Support all duct lines with timber runners in addition to cross bearers.

Do not interfere with the grading of oil filled high-tension cables, particularly to leave a high spot.

Support, in particular, parallel mains near the excavation. If the excavation is deep, and even with close timbering, the sub-soil is often drawn away, through the timbering, with the bilge, and discrimination should be used, and close attention given in the operation of pumps draining the trenches.

Before backfilling, see that other mains or services are properly supported. With deep trenches and with clay or stony sub-soil this is most important. For mains 12 in. diameter or greater a concrete support should be brought from a solid foundation to the main. The cushion between the main and the pier should be made with well caulked lead wool.

TABLE C.—*Average Cost of Cast Iron Mainlaying.*
(Open Lead Run Joints, excluding Re-instatements.)

Size of Main	4-in.	6-in.	8-in.	10-in.	12-in.
	s. d.	s. d.	s. d.	s. d.	s. d.
Materials (including normal specials)	4 6	7 0	10 0	13 0	16 0
Labour	5 0	6 0	7 0	10 0	10 0
Total	9 6	13 0	17 0	23 0	26 0

The piers should be placed behind each socket, and levels should be taken of pipes thus supported, to check for subsidence in case of later damage. Lighter mains may safely be supported on timber troughs carried on a sleeper trestle placed at pipe length intervals. The moment of inertia of the rough troughs so composed assists these smaller mains to withstand loads imposed between the supports. The space between the main and the trough is filled with clay for resilience. Property adjoining the mainlaying operations should be watched closely. An effective method to keep observation of a wall near the trench is to put a number of neat cement tell-tale strips across the joints of the masonry or brick work, which would indicate by their fracture the slightest movement in the wall.

It is not out of place to mention that in addition to this supervision during mainlaying, equal care must be given to gas supplies when other undertakings are opening the ground, and particularly in the event of deep sewering operations in the proximity of gas mains.

Testing of Mains.

The joints of all cast-iron mains should be tested when the mains are laid dead by compressed air at 30 lb. per sq.in., each joint being soaped, and, in addition, a twenty-four hour time test at 30 lb. per sq.in. With steel mains and welded joints this test pressure should be increased to 100 lb. per sq.in. The time test served to test the pipe for soundness, as well as checking the testing of the joints. Recently, on a time test of a very long section of 10-in. main, it was found that a considerable leakage was taking place. To meet traffic conditions the pipes had been filled in between joint holes after each short section had been subjected to a time test. The final test, while indicating the leakage, did not give any indication of the position of the leak. The leakage was detected by introducing into the main a pungent chemical which very quickly manifested itself through a split pipe undoubtedly caused by a stone falling on the pipes during reinstatement. The most suitable medium to use is ethyl mercaptan, and 4 oz. of this is ample for introduction to a mile of 10-in. main. This chemical has also been used to detect leaks in installations where the usual methods have been found ineffective.

Tools.

No men can give workmanship of the best class unless their tools are carefully selected. Careful consideration must be given not only to the tools, but to appliances for the safety and health of the men.

Gas masks of an Ori-Nasal type are issued to the mainlayer and his jointer, and these are sterilized in the laboratory at frequent intervals. A " Novox " portable resuscitation apparatus is kept at each distribution station and works of the Company, and one of these appliances can be taken to any part of the district in eight minutes. Recently, when a contractor's workman was gassed, this apparatus was the means of saving the man's life. Using carbon dioxide and oxygen in a proportion arranged to prevent congestion of the lungs, invariably caused by the use of oxygen only, the apparatus was used for forty-five minutes before the workman regained consciousness. Artificial respiration was applied in relays as a necessary adjunct to the apparatus, and at one stage an injection of strychnine was given by a doctor to sustain the heart action, which was very feeble.

The many other tools at the disposal of mainlayers are well known, but with all tools a careful record should be kept so that spares can be quickly and accurately ordered.

Blasting.

In a rocky district such as Torquay it is often necessary, when mainlaying, to have recourse to blasting. The usual Devon basalt outcrop in a trench is drilled to the depth required to be excavated with a maximum depth of 2 ft. 6 in. for one charge. These holes are drilled with a rock drill approximately 9 in. apart, and if the shot hole is 2 ft. 6 in. deep,, 8 oz. of gelignite would be a reasonable charge to detonate. The average cost of firing a shot with safety fuse, including drilling, is 2s.

In rocky ground particularly the trench must be marked out accurately, and as a means of setting out the trench and determining the bend required, the mainlayers are provided with large template set squares, and also with a table of offsets.

Stocks.

The stock of all mainlaying materials of this Company is kept in two depôts, at Paignton and Barton, both within easy reach of railway sidings and nearing the outskirts of the area clear of traffic congestion. Records of issues of materials from these stores are returned to the central office daily, where a record is kept on a visible card index system, so that the stock of pipes, specials, and materials can be determined exactly at any moment. The cards are checked monthly by stocktaking, and the convenience and effectiveness of the system is an aid to economy, as stocks may be kept to a minimum with the assurance that mainlayers will not be delayed by lack of material.

In conclusion, I should like to thank my Chief, Mr. R. C. Taylor, Engineer and General Manager of the Company, for the facilities he has afforded in the preparation of this Paper, and for the ready assistance of my colleagues.

Discussion.

Mr. J. H. DYDE (Plymouth), President, congratulated the Author on his Paper.

Mr. R. C. TAYLOR (Engineer and Manager, Torquay) said he considered distribution to be one of the most important phases of the Gas Industry's operations, particularly having regard to " ribbon " development and the resultant small consumption per mile of main. He further said he could vouch for the efficacy of ethyl mercaptan as a means of detecting leaks. He enquired whether the Author had experienced damage to steel mains in making welded sleeve joints; and spoke of a rubber joint he had seen taken apart after 30 years' operation mainly with benzolized gas. It was in perfect condition and quite plastic.

Mr. C. W. MANNING (Bristol) asked what depth of cover was used over mains in Torquay, also how many men were on excavating work in the gangs quoted in the paper.

Mr. A. R. LANGFORD (Torquay) asked whether the Author had experienced leaks due to scale on the pipes.

Mr. A. C. SHILSON (Weston-super-Mare) wondered why there was a difference in the costs for laying pipes of the same size in the two different tables given.

Mr. B. G. HAWKINS (Plymouth) asked whether Mr. Denton had found asbestos-cement pipes did not withstand a pressure test. He also enquired whether drawn joints had been experienced on steel mains, and whether the electrolysis on the steel mains was due to impressed electric currents or accumulated galvanic action at the joint. It would also be interesting to know how 100 yards of main were laid in a day when under the Ministry of Transport regulations not more than 100 yards of road could be opened at a time.

Mr. H. D. SULLIVAN (Plymouth) said he had known a case of a mile of main which under a pressure test had a considerable pressure drop overnight; no leak could be detected, and the main was put into commission without trouble being ex-

perienced. Did the Author insist on the pressure being maintained?

The Author's Reply.

Mr. DENTON, in reply, said the usual depth of trench was 2 ft. 6 in. with 3 ft. 0 in. at crossings, for most mains. In the gangs there were generally 8 excavator and 2 surface breakers. Regarding costs, the two cases illustrated mainlaying in long stretches and good ground, and, secondly, short stretches of main in congested and difficult conditions. He had not experienced joints leaking due to scale, but stressed the necessity of metal clean surfaces in making joints. He mentioned that if the care necessary for successful wool joints could not be given then it was better to use "run lead" joints. Tests he had made on asbestos-cement pipes did not show them to be porous at pressure up to 70 lb. per sq.in. He thought a large proportion of "drawn" joints could be traced to "sprung" pipes, and referred to the ease with which steel pipes could be bent with compressed air at 80 lb. per sq.in. and a trough-shaped coke brazier. Regarding the 100 yards restriction, this was not too rigidly enforced in his experience, but even if it were mainlaying would not be hindered in his opinion. The case mentioned of the pressure drop in a mile of main would not pass at Torquay. It may have been due to a cracked pipe but the ethyl mercaptan would have detected the fault.

Vote of Thanks.

The vote of thanks to the Author, moved by Mr. A. R. LANGFORD and supported by Mr. F. W. SANSOM (Exeter), was carried with acclamation.

PRACTICAL ASPECTS OF
Instantaneous Water Heating by Gas

by

LEOPOLD FRIEDMAN,

Chief Engineer, Technical Department,
Ascot Gas Water Heaters, Ltd.

From a Paper read before the London and Southern District Junior Gas Association on Dec. 13, in which the Author makes particular reference to the essential requirements to be observed in the design and construction of this class of heater.

It is, I believe, generally realized that the maintained popularity of a manufactured article of utility depends—to quote Mr. T. G. Noble—"on a degree of technical perfection which shall ensure the maintenance over a reasonable period of a high all-round standard in performance, utility, safety, economy, and appearance." That is to say, that the final and decisive criterion for any appliance is its ability to satisfy the user and to stand up to service conditions. Although not specifically mentioned in this Paper, is should be borne in mind that the evolution leading to present-day design and construction of gas water heaters has not been entirely the outcome of laboratory research, but is also the result of practical service experience over a number of years.

The very wide scope of the subject does not permit exhaustive treatment in this Paper, and in consequence I have only dealt with the subject in general outline. I have endeavoured to indicate the essential requirements to be observed in the design and construction of instantaneous gas water heaters.

Automatic Valves.

Safe automatic operation was not a factor in the design of early gas water heaters, and the users of such appliances were required to operate by hand the heaters installed on their premises. The first safety device I can trace was introduced in 1879 by S. Mart, who patented a small instantaneous single-point heater of a sealed type provided with a combined gas and water cock. Contrary to more recent practice, the gas was allowed to flow before the water so as to heat up the water contained in the heater prior to its displacement by the cold inlet water.

Following on this came the interlocked gas and water taps patented by J. Bartlett in 1882 in conjunction with an open type heater. The first automatic valve to be patented in England, whereby the opening of the gas valve was controlled by the flow of water, was introduced by Righton in 1888.

The essential requirements of the valve for present-day instantaneous gas water heaters can be summarized as follows:

(1) Simplicity of design. The moving parts should be as few as possible, especially in the water section.
(2) Water must flow through the appliance before gas is allowed to pass to the burner.
(3) The force operating the closing and opening of the gas valve must be sufficiently strong to ensure quick closing and effective sealing.
(4) The gas valve must open slowly so as to prevent too sudden ignition.
(5) When the heater has to be connected to a tank supply, the water pressure losses in the valve must be as low as possible.
(6) The gas and water ways must be self-contained and form separate units.
(7) The automatic valve should be readily accessible and easily dismantled.

Owing to the fact that multi-point gas water heaters were not very popular in this country until comparatively recent times, the designers of automatic valves gave their attention mainly to the design of valves suitable for single point heaters. The design and construction of such valves differ considerably from the design of valves required for multi-point pressure type heaters. In fig. 1 a diaphragm valve

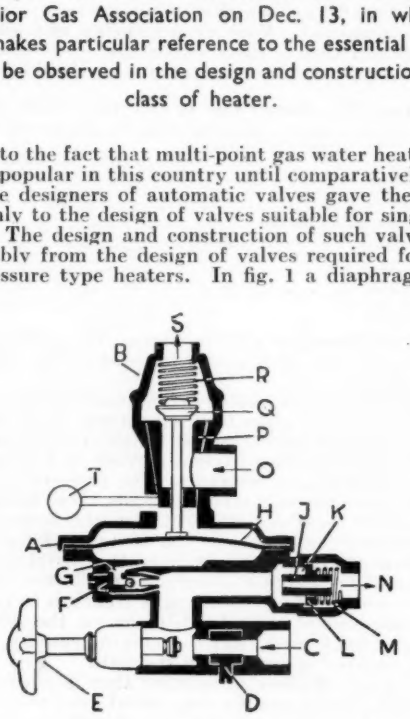


Fig. 1.

is illustrated wherein the pressure of the water, after it has passed the tap, enters the diaphragm chamber and distends the diaphragm, which is connected by a system of push rods to the gas valve. In this type it is possible to use a sufficiently strong gas valve spring to ensure quick closing. A slow ignition valve is also fitted, which restricts the flow of water into the diaphragm chamber, ensuring slow opening of the gas valve, but offers little restriction to the outward flow of the water and so gives quick closing.

For multi-point gas water heaters, which are controlled by a distant tap, the energy required to operate the gas valve must be obtained from the flow of water, and this may be achieved in the following way:

(1) By using a loose valve, loose piston, or pierced diaphragm, in the path of the water.
(2) By using a restrictor, and utilizing the difference in pressure between the two sides to act on the diaphragm, which can be made to lift the gas valve.
(3) By utilizing the difference in pressure between the inlet and the outlet of the heater, to operate the diaphragm and valve.
(4) By utilizing the difference in pressure between the throat and mouth of a venturi tube to move a diaphragm, which can be made to lift the gas valve.

Fig. 2 shows the type of valve using a restrictor to obtain the difference of pressure between two sides of the diaphragm. The general construction of this type of valve corresponds closely to that of the venturi type of valve,

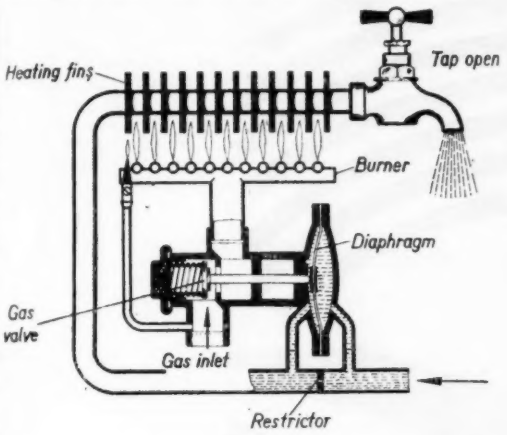


Fig. 2.

and makes a neat installation. As will be seen later, it is difficult to adapt this type to a tank supply, as the pressure loss, owing to the restrictor, is too great.

Fig. 3 shows an automatic valve using a venturi tube and bladder diaphragm. The inside of the diaphragm is the high pressure side. When a hot water tap is turned on a difference in pressure is established and the bladder is filled with water and distended. This type of diaphragm is a recent development. Its construction overcomes the difficulty of the stretching of the diaphragm, and consequent sticking of the gas valve. The design is neat and the mechanism accessible, and it also ensures the total separation of the water and gas compartments.

The use of a diaphragm for automatic valves was first

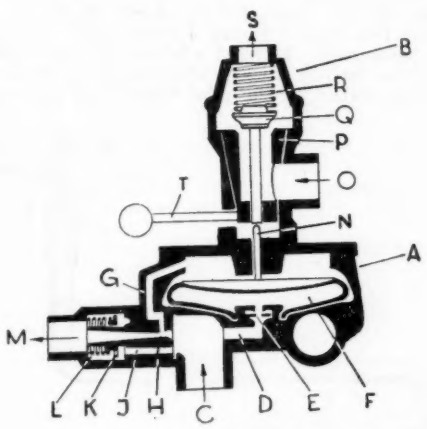


Fig. 3.

introduced into this country by Dr. Bernard Friedman, whose experience on the Continent had confirmed its reliability in service. It has since become the accepted method of operating the gas valves of water heaters. The water and gas sections can be mounted co-axially, and can therefore be enclosed very easily in the outer shell of the heater.

As previously stated, the pressure difference can be obtained either by placing a restrictor in the path of the flowing water, or by using a venturi tube. In comparing these two methods, the fact must be taken into consideration that with the restrictor method the difference in pressure is obtained by the loss of head due to friction, while with the venturi method the difference is obtained by the conversion of pressure energy into kinetic energy. Although the venturi tube used in instantaneous gas water heaters is not a perfect venturi which possesses a discharge coefficient approaching unity, yet the pressure loss to provide the same operating force is small compared with that involved by a restrictor. Fig. 4 shows the water pressure losses curves for appliances using a restrictor and a venturi tube.

With one type of automatic valve the loss of head is

2·7 ft. for the whole heater for the minimum flow of 1·2 gallons per minute. This enables appliances to be connected to a tank supply with a minimum head of 8 ft. This head includes the pressure losses in the pipe system and draw-off

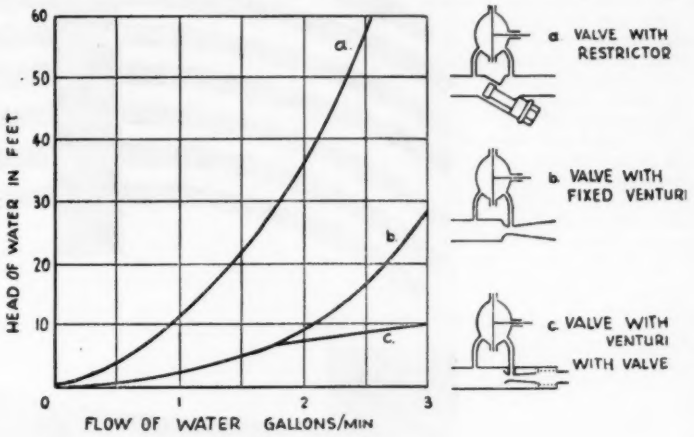


Fig. 4.

taps, which is an important factor in the choice of appliances as it is always preferable to connect multi-point gas water heaters to a tank supply, to avoid possible fluctuations of the main water pressure.

Sudden ignition, which is undesirable, owing to the momentary formation of carbon, is avoided by the use of a slow ignition valve. In addition to this, the gas valve is fitted with a flange. In the first stages of opening, the gas can only escape through the narrow annular space between the gas valve housing and the flange; when the gas valve is fully open, the bottom of the flange is above the seating, and gas can then pass at the full rate. Thus, two definite stages in ignition are obtained.

To reduce the pressure losses through the venturi tube (fig. 4) and to ensure a constant pressure difference between the two sides of the diaphragm, a sliding venturi tube was introduced, which was forced away from its seating when the minimum flow of water necessary to give the required pressure difference to operate the gas valve, was exceeded. When this occurred, by-pass ports were uncovered to accommodate the excess water, which lowered the pressure losses in the valve. For flows up to the minimum, the venturi tube was held against its seating by a light spring. The use of a sliding venturi, however, required regular cleaning of the water section, to prevent sticking of the venturi which sometimes occurred, owing to corrosion of the metal parts. To prevent this, a venturi with a valve was introduced, as illustrated in fig. 5. The venturi tube is fixed, and the valve, consisting of a porcelain disc, is held against a seating by a light spring. When the minimum flow of water necessary to provide sufficient pressure to lift the gas valve is exceeded, the porcelain disc is pushed away, un-

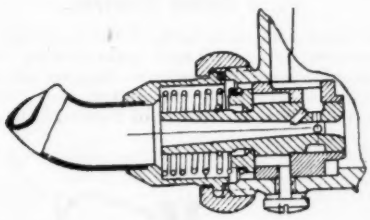


Fig. 5.

covering by-pass ducts, allowing water in excess of the minimum flow to by-pass the venturi tube.

Burners.

When considering the type of burner to be used in gas water heaters, it is important to remember that the combustion chamber is an enclosed space, and for this reason special care must be taken in the selection of a burner to ensure complete combustion under all possible unfavourable conditions.

The types of burners used for gas water heaters are:

(*a*) Flat flame burner.
(*b*) Pinhole burner.
(*c*) Bunsen burner.

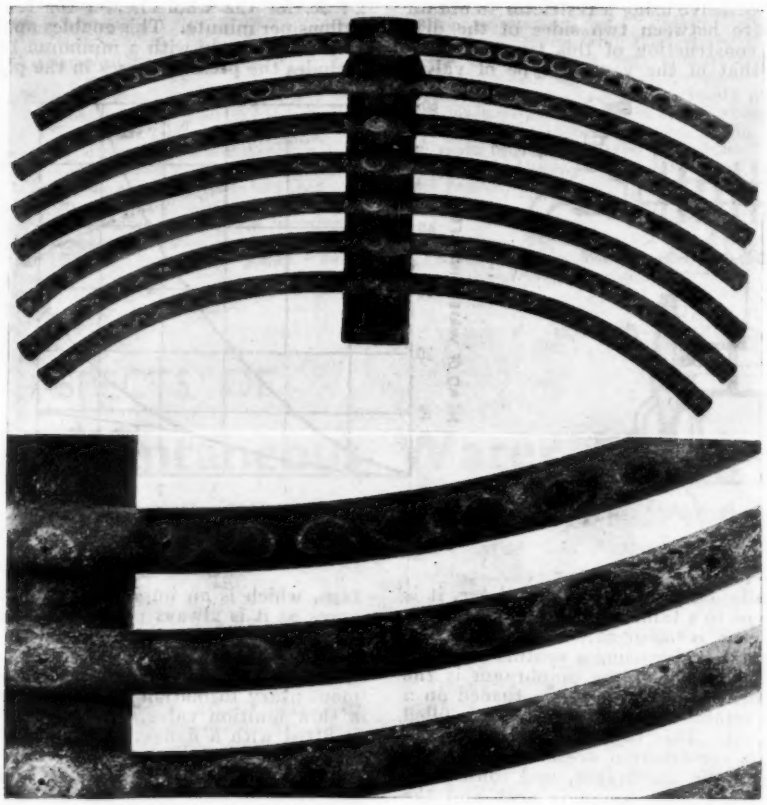


Fig. 6.

The following results are required from burners operating on gas water heaters:

(1) Even heat distribution.
(2) Highest possible aeration of gas jets.
(3) Inter-flame contact should be avoided, as this may lead to slight formation of CO.
(4) Flames should not impinge on any cold solid surface, as contact leads to flame chilling and CO formation, and with luminous burners, to carbon formation.
(5) The flames should be so disposed as to avoid any flame chilling due to contact with any solid should they be distorted by increased gas pressure.

It has been said that the life of a flat flame burner is longer owing to the indestructibility of the steatite jet. Fig. 6 is a photograph of a pinhole burner which has been in constant use for eleven years. The alteration in the size of orifices is negligible.

Pilot Safety Devices.

It is sometimes a habit to turn off the main gas cock every night to prevent any accidental leaks during the hours of sleep. This, of course, necessitates turning off all gas taps on all appliances served by the meter, and should this be overlooked, there is a possibility of a gas escape. The same

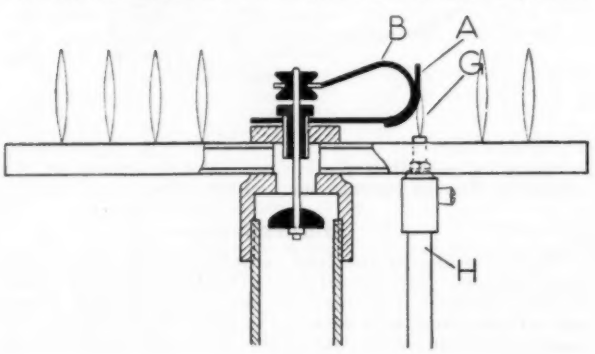


Fig. 7.

conditions exist where appliances are connected to a slot meter, and the prepaid gas has been used up.

Modern types of pilot safety devices embody some form of thermostatic control, such as bi-metallic strips or discs or thermo-couples connected to electro-magnets. Figs. 7 and 9 give two typical forms of pilot safety devices which are now being used. In fig. 7 a bi-metallic spring mounted on top of the burner is used, which opens a subsidiary gas valve when heated by the pilot flame, and allows the gas

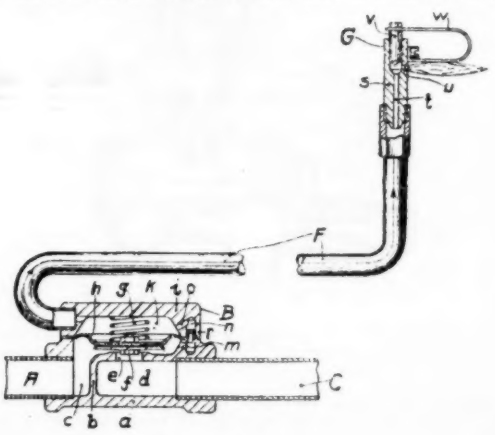


Fig. 8.

to pass to the main burner. If the pilot flame is accidentally extinguished, the bi-metallic strip contracts and closes the gas valve. The bi-metallic strip can be used as a subsidiary to the main gas valve, as shown in fig. 8. Here the operation is as follows: When the pilot flame is alight, the valve (*v*) is open and creates a difference in pressure between the two sides of the diaphragm (*h*), thus enabling the main gas valve (*f*) to open, which allows gas to pass to the main burner as soon as the automatic valve operates. When the pilot flame is extinguished, the bi-metallic strip contracts and closes the valve (*v*), thereby equalizing the pressure on both sides of the diaphragm and permitting the spring (*g*) to close the main valve.

The advantage of using this form of pilot safety device is that it ensures positive closing of the gas valve, thereby precluding any possibility of gas leakage. In the second application of this form of pilot safety device, the advant-

age lies in the fact that, on the failure of the gas supply, or the accidental extinguishing of the pilot flame, the gas is completely shut off, including the very small quantity passing to the pilot itself. But the advantage of shutting off the total supply of gas is negligible.

It has been stated that the bi-metallic strip is subject to fatigue. Tests up to 80,000 operations, however, show that this statement is incorrect, provided the strip is properly welded and annealed. No fatigue was recorded as a result of these tests.

The pilot safety device illustrated in fig. 9 makes use of a bi-metallic disc which bulges when heated. To put the appliance into operation a pilot cock (D) is turned, which allows gas to pass to the bi-metallic disc (28) and escape

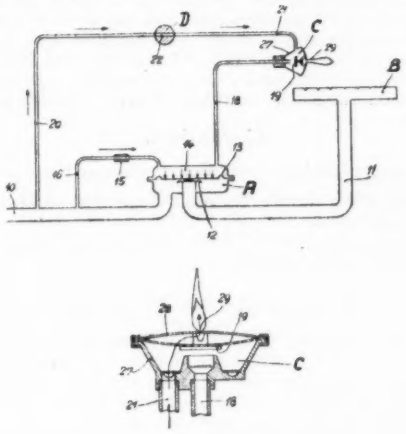


Fig. 9.

through the small drilling (29). When he bi-metallic disc is sufficiently heated it bulges and opens the gas valve (19), allowing gas to flow through by-pass (16), which contains an adjustable throttle (15). The heat from the pilot flame is sufficient to keep the bi-metallic disc in the open position. When the pilot cock is closed, the gas for the pilot flame only passes through the by-pass and creates a difference in pressure between the two sides of the diaphragm, allowing the main pressure to open the gas valve (12) and gas to pass to the burner. When the pilot flame is extinguished, the bi-metallic disc contracts and closes the valve (19). This equalizes the pressure on the two sides of the diaphragm, permitting the gas pressure to close the valve. If required, the ignition by-pass can be dispensed with, in which case the bi-metallic disc has to be heated by a match or some other means to enable it to open to put the appliance into operation.

With the introduction of pilot safety devices and their extended application, the pilot flame has ceased to be merely a device to effect automatic ignition, but is a means of ensuring fully automatic safe operation of the gas appliance.

The Combustion Chamber.

Efficient heat transfer was the chief consideration of the early designers of gas water heaters, as no standards of combustion had then been considered. As most of the early appliances were of the open type, the problem of heat transfer simply resolved itself into splitting up the water into as many finely divided streams as possible to bring as large a surface as possible into intimate contact with the ascending hot gases. With the introduction of the sealed type gas water heater, the problem became more complex, as the heat had then to be transferred through metal walls. This, together with the fact that the products of combustion from a badly designed heater could be unhygienic, led to combustion chambers being designed on more scientific lines. In the designing of a combustion chamber for a sealed instantaneous gas water heater, five matters require careful consideration:

(1) Heat transfer.
(2) Corrosion in the heater.
(3) Oxidation.
(4) Combustion of the gas.
(5) For multi-point pressure type heaters the strength of the walls of the water ways.

Heat Transfer.

The gain in thermal efficiency obtainable by condensing the water vapour in the hot gases is, for most gases, about 10%. This figure, however, is never reached, because if all the latent heat in the water vapour were to be extracted, the resulting temperature of the hot gases would be insufficient to ensure their complete evacuation into the outside atmosphere. In practice, the increase in efficiency derived from condensation may be from 5% to 7%. In this connection, I would like to mention that the difficulty of extracting the latent heat contained in the products of combustion, and yet ensuring a sufficiently high temperature for efficient evacuation, was partly overcome by an invention introduced by the Société de Gaz de Paris in 1914. Hot gases were first passed through the heat exchanger and were cooled to a temperature at which the water vapour condensed. They then flowed through flue-ways, where they were re-heated by special burners to a sufficiently high temperature to ensure the necessary flue pull. An improvement on this was made by Mr. C. A. Masterman and Mr. T. G. Noble in their invention of 1931, by which the cooled gases were re-heated by being passed over metal walls in contact with hot gases passing through the flue ways of the heat exchanger.

Heat Exchanger.

The exchange of heat in a gas water heater is carried out by convection and radiation (transfer by conduction is included in heat transfer by convection, and will be discussed later). The heat may be transferred by both these methods, but in ordinary gas water heater practice the major part of the heat is transferred by convection. In the case of heat transfer by convection, the heat has to be passed through a solid wall of metal, which is in contact on one side with a stagnant film of water and on the other side with a stagnant film of gas, and the heat is transferred through these three media by conduction. In the system consisting of stagnant film of hot gases—metal wall—stagnant film of water—the major factor affecting the total conductance is the stagnant film of hot gas, and the reduction of this is the problem in the design of the combustion chamber from the point of view of heat transfer.

The factors that tend to reduce this film are:

(*a*) High velocity of the hot gases.
(*b*) Turbulence of the hot gases.
(*c*) Numerous small flue ways in preference to larger flue ways of equivalent cross sectional area.

Up to the beginning of this century the heat was transferred directly through the walls of the water-ways, which had to be made of sufficient dimensions to ensure an adequate heating surface. Condensation was unavoidable, as the products of combustion came into direct contact with the cold metal walls. To ensure a sufficient heating surface, the gases were made to flow through devious indirect channels, but the velocities obtained were of a low order, which, as has been stated, is not conducive to efficient heat transfer.

In 1902 Prof. Junkers adopted the principle enunciated by Osborne Reynolds in 1875, " that if the velocity of the gases exceeded that necessary to produce ' eddying ,' the rate of heat transfer is approximately proportional to the velocity of flow." In view of this, Junkers proceeded to design an entirely new form of combustion chamber for gas water heaters; the functions of the heat exchanger and combustion chamber were separated, a design which has now been adopted by most up-to-date manufacturers.

The heat exchanger is mounted on top of the combustion chamber proper, and consists of a plurality of fins, which act as high temperature conductors to the walls of the water-ways. The advantages of this type are:

(1) The velocity of the hot gases through the heat exchanger is high, thereby reducing the stagnant film.
(2) Further reduction of the stagnant film is effected by the use of a great number of small flue-ways.
(3) A large heating surface is available for a very small volume, thereby making a compact form of heat exchanger.
(4) The heat exchanger can be designed to give a temperature gradient at the walls of the water-ways which precludes condensation.
(5) As the major portion of the temperature head is required to overcome the resistance of the stagnant film, the surface required for the transfer of heat from the hot gases to the metal must be greater than that required to transfer the heat from the metal to the water, and with this type of heat exchanger this can be easily achieved.

Before proceeding further with the consideration of combustion chambers from the point of view of heat transfer, it is necessary to know the structural differences involved between the open outlet single point heater, which is not subjected to water pressure, and the multi-point pressure type appliance. In the former, the water can be allowed to flow between the two walls of metal, which permit an

adequate heat transferring surface to be available. In the latter case, the use of large water backed surfaces is precluded owing to the pressure of water. The water-ways therefore consist of metal tubes formed into coils, or of straight tubes passing through a multiple-finned heat exchanger.

In fig. 10 a finned type heat exchanger is employed. The construction of the fins is illustrated in the sectional plan. To prevent condensation and corrosion in the lower portion of the hollow metal wall which surrounds the combustion chamber, and through which the water passes, an inner shell guard is provided which, owing to the air space between it and the metal wall in contact with the water, is kept at a temperature above dew point.

Fig. 11 is a heater of the type where the combustion

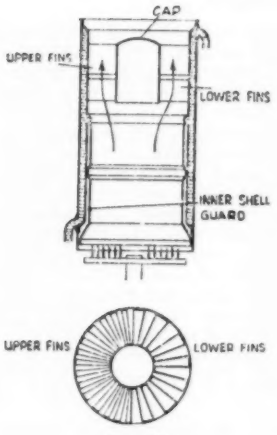


Fig. 10.

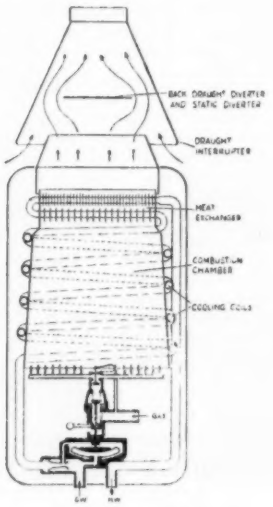
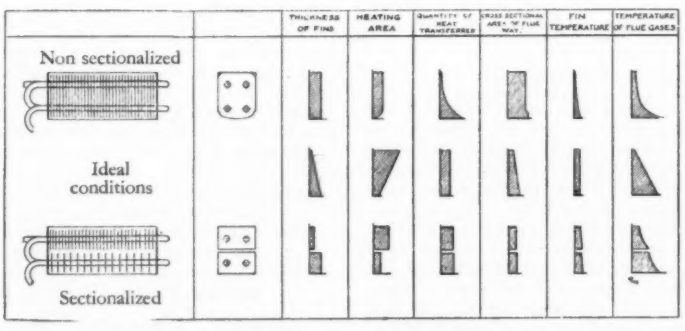


Fig. 11.

chamber is separated from the finned type heat exchanger. As equalization of heat transfer is desired, the heat exchanger is made in two sections. In the lower half, where the temperature of the hot gases is at a maximum, the number of fins is smaller than in the upper half, where the gases have rejected some of the heat and a lower temperature prevails. The relative area of the flue-ways is so arranged that the velocity of the hot gases is constant throughout. A high velocity is ensured by the tapering shape of the combustion chamber and the comparatively small area of the flue-ways. This construction enables the use of thicker copper for the lower fins, where the more severe conditions for corrosion are present. Fig. 12 illus-



Diagrammatic representation of conditions obtaining in a non-sectionalized and sectionalized finned type heat exchanger compared with the desired ideal conditions.

Fig. 12.

trates the various conditions obtaining in a finned type heat exchanger. The centre section represents the ideal conditions for a heat exchanger of this type. The top section is a non-sectionalized heat exchanger, wherein the flue-ways are of equal dimensions throughout. In the lower section the heat exchanger is divided into two parts, the advantage being that the temperature and heat exchange gradient curves, &c., correspond closely to the ideal.

Although, from a user's point of view, it is true to say that there is no condensation in this type of appliance, in practice it is impossible to avoid a certain amount, which appears in the form of a light dew, where the first few fins are brazed on to the first water tube entering the heat exchanger. Further, it is impossible to avoid a certain amount of condensation at the beginning of each operation when the fins and water-ways are cold. This, however, is quickly evaporated and does not run out of the heater. A light dew is also formed where the cooling coil is in contact with the combustion chamber.

To keep the combustion chamber at the right temperature, the number of turns in the cooling coil is carefully adjusted.

Effect of Scale on Heat Transfer.

The amount of resistance to heat transfer caused by scale is more dependent on the nature of the deposit than on its thickness. Although the formation of scale in gas water heaters where the temperature seldom rises above 160° F. is comparatively slow, and consequently the thin layer formed is not sufficient unduly to affect heat transfer, yet its effect or corrosion and oxidation can be appreciable and its formation should be avoided as far as possible.

Corrosion.

In gas water heaters corrosion can occur through:

(1) Formation of salts through the action of H_2SO_4 on the metals used.

(2) Formation of NO and NO_2, which combine with water vapour to form HNO_3.

Corrosion Due to H_2SO_4.

Useful information is available from the Joint Research Committee of The Institution of Gas Engineers and Leeds University, regarding the relative effect of the H_2SO_4 in the condensate of the products of combustion on the metals used, but the conditions under which these tests were carried out are hardly those obtaining in gas water heaters. The conditions obtaining for non-condensing gas water heaters correspond to those mentioned by Prof. J. W. Cobb, of Leeds University, when he said that the method of attack still to be investigated was when the temperatures were too low to result in oxidation and too high to permit condensation. It is to be hoped that an investigation of this aspect of corrosion will be instituted. In this connection it must also be remembered that the "need for maintenance arose not from the complete destruction of the appliance, but by reason of the corrosion products building up and interfering with combustion and performance."

It is difficult to estimate the exact chemical reactions which take place when the hot gases pass through the heat exchanger, but it is certain that SO_3 is formed, because SO_2, which is one of the normal constituents of the products of combustion of town gas, is unaffected by oxygen alone, but combines readily with the free oxygen to form SO_3, when water vapour at a high temperature is present. As H_2SO_4 vapour dissociates at temperatures above 500° C. into SO_3 and H_2O, it is clear that some H_2SO_4 in vapour form will be present in the hot gases passing through the heat exchanger. H_2SO_4 vapour condenses at a temperature of approximately 340° C., also, when the SO_3 formed by the oxidation of SO_2, together with the H_2O already present in the hot gases, comes in contact with the fins or other parts of the heat exchanger, H_2SO_4 will be formed and will condense in globules, but will immediately be evaporated. The quantity of H_2SO_4 thus formed will depend upon the velocity of the gases and the condition of the surface. The scrubbing action of wet surfaces on the H_2SO_4 vapour will be higher than of a dry surface, and therefore the deposition of liquid H_2SO_4 will take place more rapidly and to a

greater extent in a condensing than in a non-condensing appliance.

These conclusions show how there is the possibility of direct formation of H_2SO_4 in the heat exchanger of a gas water heater, and indicate how corrosion from H_2SO_4 may be set up in a non-condensing appliance. Thus in a non-condensing appliance corrosive action due to H_2SO_4 only may arise from direct oxidation of SO_2 to SO_3, with momentary condensation on the solid surface of the heat exchanger of minute globules of H_2SO_4 which are immediately evaporated, and the corrosive action of which is therefore limited.

In the case of a condensing appliance, however, this is supplemented by the formation of H_2SO_3, which is oxidized by the free oxygen to H_2SO_4. Owing to the scrubbing action of the condensate, a greater quantity of H_2SO_4 is formed, and although this is at a low concentration on account of the presence of the condensate, the concentration rapidly increases at points where re-evaporation occurs, and the attack will be correspondingly more severe. The accumulation of deposits at these points, which, as previously stated, is the criterion of the frequency of maintenance, will be excessive.

The properties of metals used for combustion chambers must be carefully considered in view of these facts. The use of bare copper on which the effect of H_2SO_4 formed from the products of combustion falls within the intermediate group should be discouraged, especially in the case of condensing appliances.

Experience which has been confirmed by research has shown that the metals which offer most resistance to corrosion from products of combustion are tin and lead and their alloys, such as solder. It is, however, impracticable to construct a heater made entirely of these two metals, and tinned copper, which possesses both mechanical strength and high heat conductivity, is usually employed. Where the conditions for corrosion are most severe, such as in the heat exchanger, the parts should be lead coated in addition to being tinned. Although it is impossible to construct an appliance of entirely incorrodible material, the above practice reduces corrosion to a minimum.

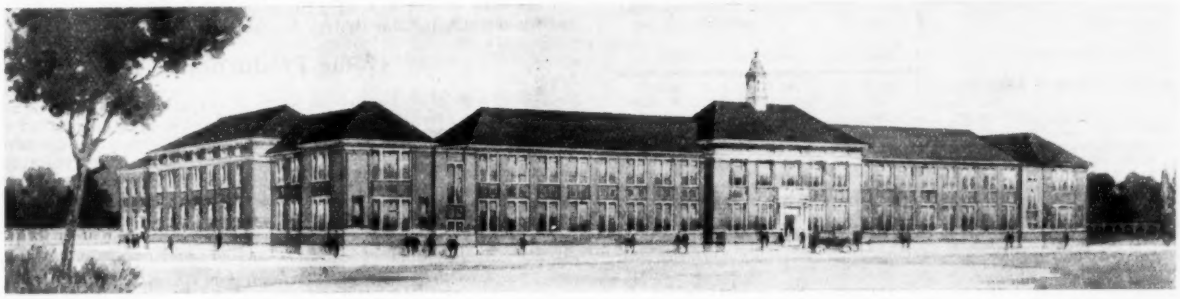
Treatments of other metals than copper to ensure an incorrodible coating have been evolved and are now undergoing intensive tests, and may be adopted for gas water heaters in the future. Corrosion and heat resisting materials have also been used in certain cases.

Corrosion Due to NO and NO_2.

HNO_3, found in the products of combustion, is of small importance as a corroding agent when compared with H_2SO_4. The NO formed is non-corrosive until it is oxidized, and its oxidation is slow at the concentrations met with in the products of combustion of town gas. The amount of HNO_3 formed is greatly influenced by the velocity of the hot gases and the length of travel through the heat exchanger. A finned type heater exchanger is therefore most suitable. The fact that the formation of HNO_3 increases with the decrease of the sulphur contents of the gas, however, points to the fact that the importance of the formation of NO and NO_2 lies not in their direct corrosive effect, but in the possibility of the NO becoming oxidized to NO_2 and combining with the water vapour, nitrogen, and SO_2 present to form H_2SO_4.

(To be continued.)

UP-TO-DATE GAS EQUIPMENT



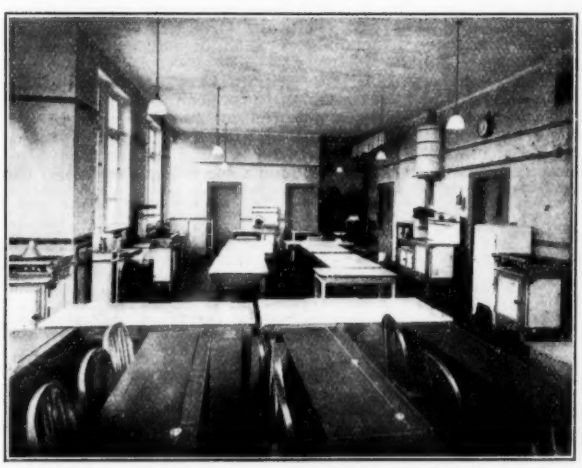
There is ample evidence that gas is relied upon to play its full share in the vocational and domestic training which students will receive at the magnificently equipped new Technical College at Southport.

At Southport's New Technical College

In the Domestic Science Section modern methods of cooking in all its branches, both elementary and advanced, are taught to young scholars and to adults also, and gas is the principal means employed for cooking in this well-designed Centre.

Our illustration shows part of the Domestic Science Room and includes five large " Bungalow " " New World " cookers by Richmonds Gas Stove Company, Ltd. (Radiation Ltd.). One of these cookers, it will be noted, is a level-top range with separate warming compartment beneath the hotplate burners. All are " Regulo " controlled and finished in grey mottled porcelain enamel. Here every variety of dish (including full course meals) is prepared and cooked by the students, while the theoretical side of the training is conducted at the desks shown in the foreground. The electrical refrigerator which stands beside the door has since been replaced by one which is gas-operated.

This installation is typical of what is being done all over the country and serves to emphasize the strong position which gas enjoys in the public mind. The preference for gas appliances is not haphazard, it is the just reward of merit—gas is chosen simply because it does its job better, quicker, and cheaper than by any other method. Cookery Centres of this kind enable the young generation to grow up knowing these facts, it makes them gas-minded and leaves them skilled in the art of good cooking. The whole of the gas appliances in use in this new Technical College have been supplied and fitted by the Southport Corporation Gas Department under the direction of Mr. J. Herbert Clegg (Engineer and Manager), who is to be congratulated upon scoring yet another success for gas.



A view of the Domestic Science Room.

British Sulphate of Ammonia Federation

Annual Report for 1934-35

The following figures are offered as fair estimates, but strict accuracy is not claimed for them. The estimates for 1933-34 have been slightly revised. The percentage increases or decreases as compared with the previous year are shown in italics.

World Production and Consumption of Pure Nitrogen for the Fertilizer Years.

[In Metric Tons.]

	1932-33.	1933-34.	1934-35.
Production—			
Sulphate of ammonia—			
By-product	257,719	307,050	315,905
Synthetic	559,984	534,743	519,829
	817,703	841,793	835,734
Cyanamide	168,495	195,245	238,448
Nitrate of lime	118,241	107,192	153,113
Other forms of nitrogen*—			
Synthetic	462,060	515,477	591,242
By-product	39,560	48,259	44,429
Chile nitrate	70,800	84,300	178,400
Total production	1,676,859	1,792,266	2,041,366
Percentage increase or decrease	*+ 5·8*	*+ 6·9*	*+13·9*
Consumption—			
Manufactured nitrogen	1,619,705	1,714,040	1,836,506
Chile nitrate	127,242	163,550	194,355
Total consumption	1,746,947	1,877,590	2,030, 61
Percentage increase or decrease	*+ 12·3*	*+ 7·5*	*+ 8·2*
Agricultural consumption about	1,586,000	1,673,000	1,792,000
Percentage increase or decrease	*+ 12·3*	*+ 5·5*	*+ 7·1*

* Including nitrogen products used for industrial purposes (except Chile nitrate) and ammonia in mixed fertilizers.

NOTE.—Fertilizers are included in these tables under the final form as sold, so that, for example, cyanamide if converted into sulphate of ammonia is included under synthetic sulphate of ammonia, or, if into ammophos, is included under other synthetic nitrogen.

During the year under review it is estimated that there was an increase of **249,100** metric tons of nitrogen, or about **13·9%**, in the actual production of the forms of nitrogen enumerated above. The production in Chile increased by **94,100** tons, or over **111%** (following an increase of about **19%** in the previous year), and output in other countries increased by **155,000** tons, or **9%**.

The most marked increases in manufactured nitrogen output have been in Russia, Germany, and Japan.

While production thus shows an improvement, synthetic nitrogen plants have on an average operated at only about **43%** of capacity during the year; the world production capacity for synthetic nitrogen, including cyanamide, is estimated at **3,490,000** tons of nitrogen.

The total consumption increased by **153,271** tons, or about **8·2%**, following an increase of **7·5%** last year.

The increase in fertilizer nitrogen consumption was **119,000** metric tons, or **7·1%**, as compared with **5·4%** in the previous year. Each main class of fertilizer showed an increase; ammonium sulphate (including ammonia for mixed fertilizers) increased by **48,532** tons of nitrogen, or **5·8%** over the **1933-34** figure.

In individual countries, the largest tonnage increases in nitrogen consumption have been in Germany, Russia, Japan, the U.S.A., and Italy, and the greatest decrease in France.

The development in recent years of production and consumption of "other synthetic nitrogen fertilizers," particularly of lime ammonium nitrate forms, which was mentioned in last year's Report, has continued. Sulphate of ammonia, however, retains the preponderance among the world's nitrogenous fertilizers, as it represents over **45%** of the fertilizer nitrogen production and consumption.

The agreements with the most important continental nitrogen producers and with the Chile nitrate industry have been renewed, with certain modifications which experience has shown to be desirable.

Substantial progress has been made towards the continuance and extension of the Agreement with the Japanese producers.

The nitrogen industry of the world can now, saving unforeseen events, reasonably look forward to increasing stability over the next three years.

While the credit for initiating and carrying through these arrangements belongs to the organized groups of nitrogen producers in Europe, their task has been facilitated by the practical recognition of the value of such international arrangements by the Governments concerned.

Thus, during the summer of **1935** the British Government put British nitrogen producers in a position of practical equality with makers in Europe by the imposition of a high specific duty on imports of sulphate of ammonia and certain other forms of nitrogen entering the British home market.

Home Production.

The figures in the following table showing the total production of ammonia products, expressed as sulphate, are calculated on the basis of **25%** ammonia (about **20·6%** nitrogen). The figures for sulpnate of ammonia production and trade, however, apply to actual tons of product with a nitrogen content varying from an average of about **20%** in the earlier years to about **21%** in recent years.

Production of Ammonia Products and of Ammonium Sulphate in Great Britain and Ireland and Channel Islands.

[Tons of 2,240 lbs.]

Calendar Year.	Total Production of Ammonia Products, Expressed as Sulphate of Ammonia Equivalent (Basis 25% Ammonia).*				Included in the Total.	
	England and Wales.	Scotland.	Ireland.	Total Great Britain and Ireland.	Industrial Ammonia Products (Basis 25% Ammonia)†	Sulphate of Ammonia as such (Actual Tons of Product.
1932.	726,253	42,121	3,106†	771,480	85,505	628,349
1933.	647,149	41,669	3,857†	692,675	94,361	574,743
1934.	560,526	45,522	3,961†	610,009	114,549	446,298

* 25% ammonia = 20·6% of nitrogen (approx.). The figures for total production of ammonia products are recalculated from the Alkali Inspectors' Reports, except for the estimates shown. The Alkali Inspectors' Reports included Ireland up to 1921, so that to obtain comparable totals estimates for Ireland have been included for the years 1922-1934.

† Estimated.

Great Britain and Ireland and Channel Islands.

[Tons of 2,240 lbs.]

Fertilizer Year.*	Total Production of Sulphate of Ammonia as such.	Agricultural Consumption of Sulphate of Ammonia in —				Agricultural Consumption of Chile Nitrate.†	Sulphate of Ammonia.	
		England, Wales, and Channel Islands.	Scotland.	Ireland.	Total British Isles and Channel Islands.		Exports from—	Imports into—
							Great Britain and Ireland other than to or from the Channel Islands.	
1932-33	598,528	150,704	51,570	36,369	238,643	20,000	335,173	226
1933-34	508,463	129,532	47,944	33,246	210,722	22,000	301,460	1,666
1934-35	430,366	133,384	43,309	34,450	211,143	26,000	247,081	5

* Years ended June 30. † Estimated.

Home consumption of sulphate of ammonia showed an increase on the 1933-34 figures of 421 tons, or 0·2%. Prices during the principal consuming months were practically the same as in 1933-34. As will be seen from the table, the decline in consumption in Scotland was counterbalanced by increases in England and Wales and in Ireland.

Foreign imports amounted to only 5 tons, against 1,666 tons in 1933-34.

The total consumption of pure nitrogen in the British Isles for all purposes amounted to about 81,400 metric tons against 78,700 tons last year, an increase of 3·4%. The tonnage used in industry is estimated at 24,200 tons, against 23,500 last year.

The detailed figures for sulphate of ammonia are as follows:

N.B.—The total consumption of Chile nitrate is estimated at 33,300 tons, as against 25,300 tons for last season.

Exports.

Total exports from Great Britain and Ireland show a decrease of 54,384 tons, or about 18% on last year's figures, but during the year there has been a further reduction in the stocks on hand in our export markets.

The following figures show the shipments to the principal markets:

	1932-33.	1933-34.	1934-35.
Spain, Portugal, and Canaries	137,570	114,585	93,349
Japan	3,000	64,315	7,025
China and Hong Kong	59,817	13,441	6,950
West Indies, British Guiana, and Mauritius	30,952	22,534	25,361
India and Ceylon	48,771	51,274	58,172
Australia and New Zealand	25,869	13,285	18,781

Propaganda Work.

A considerable change has occurred over the whole face of British agriculture during the past twelve months. The various marketing schemes have been getting into their stride, and while the Milk and Pig Boards particularly have still many difficulties to overcome, there is more confidence that these efforts at producer organization will eventually bear their share in the recovery of agriculture. They have already done much to improve the producer's position without serious interference with consumer interests. The average agricultural price index for the year ended June, 1935, was 115 compared with 109 for 1933-34. If payments under the wheat and cattle subsidies be included the corresponding figures are 119 and 109 respectively. The farmer's financial position, however, has not yet recovered from the effects of the past, and there is still a general tendency to restrict purchases of fertilizers, feeding-stuffs, and implements to the margin of bare necessity.

Memory of the low price of sulphate of ammonia in 1932 has not yet faded from the minds of farmers, but as each year passes they tend to become more reconciled to the present reasonable levels. The three successive dry summers have, of course, provided unfavourable climatic conditions for the full appreciation of the benefits of fertilizers generally, although other benefits have arisen therefrom to improve the farmer's position.

The staff of local representatives in the field has been enlarged and other changes made in the organization to ensure closer contact and co-operation with merchants.

The usual summer shows, including the very successful Royal Show at Ipswich, were visited. Co-operation has also been secured with local agents at an increased number of county shows. Lectures were given as usual throughout the winter months and attendances continue to be satisfactory.

A change was made in respect of the window display models hitherto sent on loan to gas undertakings. The old models, having served their purpose, were withdrawn and replaced by an entirely new window display offered to gas undertakings for their permanent retention. This proved a popular innovation and 46 undertakings took advantage of it. Over 100 window displays were used; with the new arrangements large undertakings were able to stage simultaneous displays at their several showrooms. It is known that these shows have led to some increases in the local sales of sulphate of ammonia, particularly in small packages.

During the year three agricultural talking films—the first of their kind—have been completed for use in the home market and will be shown throughout the country during the winter season of 1935-36. The first of these is primarily of entertainment value, the second deals with top-dressing in all its aspects, and the third with the manuring of potatoes and sugar-beet. In all of these films the importance of nitrogen is stressed throughout.

The past year has been a record for visitors to Jealott's Hill, there being a total of 3,019, of whom 421 came from overseas.

Propaganda activities have been continued in most of our markets overseas.

Membership.

Two former members, on resuming production, rejoined the Federation during the year, but owing to amalgamation or liquidation two members ceased membership. The list of members at June 30, 1935, remained at 211 members, being the same total as for the previous year.

Abridgment of Prospectuses.

THE DUDLEY, BRIERLEY HILL AND DISTRICT GAS COMPANY.

Issue of £33,000 4% Redeemable Debenture Stock 1950-1960, at £100 per cent.

„ „ £17,000 5% Consolidated Preference Stock by Tender Minimum Price, £110 per £100. Yielding at that price £4 10s. 11d. per cent.

These Issues will be made concurrently under separate Prospectuses.

The Subscription List for the 4 per cent. Redeemable Debenture Stock will OPEN ON THE 6TH JANUARY and will CLOSE ON OR BEFORE THE 9TH JANUARY, 1936.

The Tenders for the 5 per cent. Consolidated Preference Stock will be received on or before 12 noon on 13th January, 1936.

The 4 per cent. Redeemable Debenture Stock now offered has been created under powers conferred by the Dudley Gas Acts and Orders, 1853 to 1931, and ranks as to principal after the existing Loan Capital, but *pari passu* as to interest. Interest will be paid on 1st September next covering the period from 1st April to 31st August, 1936; thereafter it will be payable half-yearly on the 1st March and 1st September.

The 5 per cent. Consolidated Preference Stock now offered has been created as an addition to the existing 5 per cent. Consolidated Preference Stock, all ranking *pari passu*. Dividends will be paid on 1st September next covering the period from 1st April to 30th June, 1936; thereafter it will be payable half-yearly on 1st March and 1st September.

Applications for the 4 per cent. Redeemable Debenture Stock, and Tenders for the 5 per cent. Consolidated Preference Stock, on forms provided, must be for amounts of not less than £10 and in multiples of £1, and be accompanied by a deposit of 10 per cent. of the nominal amount applied or tendered for. The balance of the purchase money, including the premium in the case of Tenders, must be paid on or before 31st March, 1936. These Stocks, when fully-paid, will be registered and transferable in multiples of £1.

The 4 per cent. Redeemable Debenture Stock will be repayable at par on 1st September, 1960, but is redeemable in whole at the option of the Company, at 100 per cent. on or after 1st September, 1950, on not less than six months' notice in writing.

Certificates for both kinds of Stock will be issued in exchange for fully-paid allotment letters after 30th April, 1936.

No portion of these Issues has been or will be underwritten.

The Net Revenue for the year ended 31st December, 1934, as shown by the audited accounts was	£22,667 8 7
Deducting Interest on Loan Capital, INCLUDING THE DEBENTURE STOCK NOW BEING ISSUED	6,621 10 0
There remains a balance of	£16,045 18 7

The Mortgage and Debenture Stock interest (including this Issue) was therefore covered nearly 3½ times, and the Preference Stock dividend nearly four times.

The Directors fully anticipate the Net Revenue for 1935 will exceed that of 1934.

The Town of Dudley Gas Light Company was first Incorporated by Act of Parliament in 1821 and The Brierley Hill District Gas Light Company in 1849. The two Companies were amalgamated in 1931.

Both Companies paid their maximum statutory dividends for over fifty years prior to the date of their amalgamation on 1st October, 1931, and the new Company has paid full statutory dividends since that date.

The area of supply comprises the County Borough of Dudley, the Urban Areas of Brierley Hill (which includes Quarry Bank and Kingswinford, except a portion of the District of Wordsley), the Parishes of Wombourn, Himley, Kinver, and a small part of the Urban District of Sedgley, covering some 35 square miles with a population of over 100,000.

The number of consumers, the number of street lamps, and the output of gas are constantly and consistently increasing. The number of consumers has increased during the two years ended September, 1935, by over 6·6 per cent. and now amounts to some 23,000.

The output of gas for 1934 exceeded 517 million cubic feet (approximately 2½ million therms). The sales of gas in 1934 were 2·2 per cent. more than in 1933 and during the first three quarters of 1935 (the latest figures available) were 4·4 per cent. more than during the corresponding period of 1934.

More gas appliances are being sold, and more gasfitting work carried out by the Company than ever before in its history.

Local Authorities in the Company's area have planned to erect at least 1,100 houses in the near future, and building by private enterprise is still extensive.

Furnaces are now being installed by consumers in the Company's area which will, it is estimated, consume gas at the rate of approximately 50 million cubic feet per year, equal alone to an increase of over 10 per cent. in sales of gas. In some cases contracts have been obtained for the use of gas in these furnaces for three years.

The plant at the Dudley Gas Works was modernised and extended in 1932.

It is necessary in view of the further rapid increase in the sales of gas, to increase still further the gas-making plant immediately. The proceeds of the present issues of Capital will be utilised to repay advances by the Company's Bankers necessitated by recent Capital Expenditure on Coke grading plant and upon distribution plant for the housing extensions of local Authorities and to enable the Company to provide for the further extension of housing schemes, and for the extension of the gas-making plant.

Brokerage of 5s. per cent. will be paid on allotment in respect of accepted applications and Tenders bearing the stamp of Bankers, Stockbrokers, Solicitors, or Accountants.

Copies of the Company's private Acts and the resolutions creating the Stocks now offered can be seen at the Offices of the Company at Spring Gardens, Dudley, at any time during business hours, for a period of seven days following the date of the Prospectuses, and the Company's last audited Statement of Accounts can be obtained on application to the Secretary.

Copies of the full Prospectuses and Forms of Application and Tender can be obtained at the Offices of the Company, from Barclays Bank, Ltd., High Street, Dudley, and branches of that Bank in the Midlands, from Messrs. GRIFFITHS & LAMB, 104 and 106, COLMORE ROW, BIRMINGHAM, 3, Messrs. SLATER & CAMM, 198, WOLVERHAMPTON STREET, DUDLEY, or Messrs. GOUGH & WRIGHT, 267-8, CASTLE STREET, DUDLEY.

By Order of the Directors,
GEORGE E. ASHURST,
Secretary.

Spring Gardens,
Dudley, Worcestershire,
31st December, 1935.

1843
to
1936

In noting the entry of yet another unit on our score card may we be permitted to express our appreciation of the support that we have received from our many friends in the Industry: not that we need physical support though we are approaching our century, but rather that we have indeed welcomed their goodwill and custom during the difficult years of the economic depression. We have been happy to see during the past year the return of many old customers, and we look forward to renewing many other friendships during the present year.

We shall continue to uphold the policy of Quality and Service which we have followed for nearly a century.

ALEXANDER WRIGHT & CO LTD

Gas Markets and Manufactures

Stock Market Report

(For Stock and Share Lists, see later pages)

Investors and speculators were in holiday mood last week, and though the Stock Exchange was open for three days there was very little business done. Similar conditions are anticipated during the greater part of the current week on account of the New Year's holiday, though a return to more active conditions is expected towards the close, especially in the gilt-edged market after the banks and other big buyers have satisfied their end-year balance-sheet requirements. It is satisfactory to note, however, that prices generally have kept firm with a tendency to rise, so that when 1936 really starts the Stock Exchange should be busy.

There is little to report regarding Gas stocks and shares. As in other sections the volume of business was small, though here again prices showed a hardening tendency, and in several instances appeared to justify some further appreciation in the quotations. The only changes occurred in Shrewsbury ordinary, which recorded a sharp rise of 5 points to 149½, business being done at 150½-151, and in Bournemouth 5% debenture stock, which recovered the 2 points drop *ex* div., closing at 125½.

The next item of interest to gas investors will be the publication of annual reports and accounts. It is probable that the majority of companies operating at home will distribute at least the usual rates of dividend, for though the climatic conditions until December varied little from those of 1934, when except in two cases the rates were maintained, during the first three weeks of the latter month some remarkable increases in gas output are known to have been recorded.

Current Sales of Gas Products

The London Market for Tar Products.

Dec. 30.

There are no changes in the prices of tar products, which remain as follows:

Pitch, about 40s. per ton f.o.b.

Creosote, 5⅛d. to 5⅜d. per gallon.

Refined tar, 4d. per gallon in bulk at makers' works.

Pure toluole, 2s. 9d. to 2s. 10d.; pure benzole, 1s. 7d. to 1s. 8d.; 95/160 solvent naphtha, 1s. 8d. to 1s. 9d.; and 90/160 pyridine, about 4s. 9d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Dec. 30.

The average prices of gas-works products during the week were: Gas-works tar, 24s. 6d. to 29s. 6d. Pitch—East Coast, 42s. 6d. to 45s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 42s. 6d. to 45s.* Toluole, naked, North, 2s. 1d. to 2s. 3d. Coal-tar crude naphtha, in bulk, North, 7¾d. to 8d. Solvent naphtha, naked, North, 1s. 5¾d. to 1s. 6½d. Heavy naphtha, North, 1s. to 1s. 1d. Creosote, *ex* works, in bulk, North, liquid and salty, 4¾d. to 5d.; low gravity, 4½d. to 4⅝d.; Scotland, 4¾d. to 5d. Heavy oils, in bulk, North, 4¾d. to 5d. Carbolic acid 60's, 2s. 4d. to 2s. 6d. Naphthalene, £13 to £15. Salts, 75s. to 80s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Dec.* 28.

Owing to the holidays business has been on restricted lines, but prices are, nevertheless firm in all departments, and the tendency would appear to be towards still higher prices.

Crude gas-works tar.—The actual value is 30s. to 31s. per ton *ex* works in bulk.

Pitch shows no alteration, at 35s. to 37s. 6d. per ton f.o.b. Glasgow for export, and round 35s. per ton *ex* works in bulk for home trade.

Refined tar is still quoted at 2½d. to 2⅝d. per gallon f.o.r. makers' works in buyers' packages, according to quantity.

Creosote oil.—Stocks continue low and new production is well looked after. B.E.S.A. Specification, 5¼d. to 5½d. per gallon; low gravity, 5⅜d. to 5⅝d. per gallon; and neutral oil, 5⅜d. to 5⅝d. per gallon; all f.o.r. in bulk.

Cresylic acid.—With supplies particularly scarce in this district, values are nominal as follows: Pale, 97/99%, 1s. 5d. to 1s. 5½d. per gallon; dark, 97/99%, 1s. 3d. to 1s. 3½d. per gallon; and pale, 99/100%, 1s. 5d. to 1s. 6d. per gallon; all *ex* works naked.

Crude naphtha shows a slight improvement to 5¼d. to 5⅜d. per gallon, according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 4d. to 1s. 4½d. per gallon, and 90/190 heavy naphtha is 11½d. to 1s. per gallon.

Motor benzole is commanding 1s. 3½d. to 1s. 4d. per gallon in bulk at makers' works, but supplies are on the short side.

Pyridines.—90/160 grade is 5s. to 5s. 6d. per gallon, and 90/140 grade, 5s. 6d. to 6s. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole . . .	0 9½	to	0 10	per gallon at works
Motor ,, . . .	1 3	,,	1 3½	,, ,, ,,
90% ,, . . .	1 4	,,	1 4½	,, ,, ,,
Pure ,, . . .	1 7½	,,	1 8	,, ,, ,,

Contracts Advertised To-Day

Carburetted Water Gas Plant.

Mansfield Gas Department. [p. 52.]

Purifier Repairs.

Mansfield Gas Department. [p. 52.]

Trade Notes

Jackson Boilers, Ltd., Profit-Sharing.

At a recent meeting of the staff and workpeople of Jackson Boilers, Ltd., Vulcan Works, Leeds, Mr. A. G. Barrow (Managing Director) announced that the sales for the year ended Nov. 30 had broken all records. The results were so gratifying that the Directors had sanctioned the payment of a bonus to all their employees equal to 12½% on wages and salaries earned over the twelve months. Mention was made of the fact that since the Company was incorporated over 25 years ago, it has voluntarily distributed a share of the net profits every year in this manner.

Diaries, Calendars, &c., Received

Seasonable gifts in the shape of useful diaries, calendars, &c., have been received from the undermentioned friends, whose good wishes are heartily reciprocated:

Clay Cross Company, Ltd., near Chesterfield.
W. C. Holmes & Co., Ltd., Huddersfield.
Simon-Carves, Ltd., Cheadle Heath, Stockport.
Yorkshire Coking and Chemical Company, Ltd., Castleford.

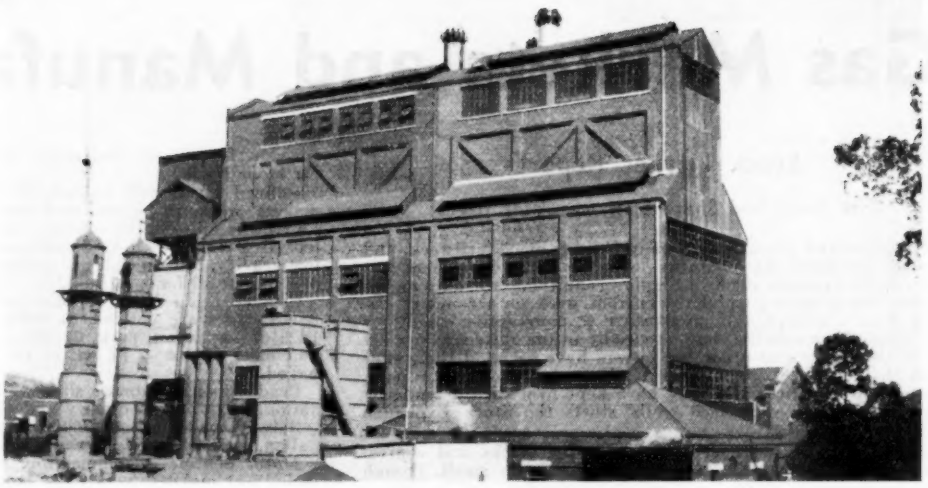
Retort House Extensions at Morecambe

The Morecambe Council has approved the acceptance of the tenders for two retort house settings at a total cost of £1,004.

Councillor Carleton, who moved that the recommendation be referred back for further consideration, said there was a very definite intention on the part of the Council to remove the gas-works to another site at the earliest possible moment. The expenses now under consideration was merely temporary expenditure.

Alderman Wilson made it clear that there was no definite resolution from the Council at the present moment sanctioning the removal of the gas-works. He could assure the members that there was nobody keener than he was to have the gas-works removed, and he would even go so far as to support an additional rate in order to get them removed quicker.

A new picture from South Africa showing (left) the first installation and (right) the second installation of Glover-West vertical retorts built to the order of the Johannesburg Municipal Gas Department at the Cottesloe gas works.



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LONDON: Columbia House, Aldwych, W.C. 2 — 'Phone: HOLBORN 4108 : 'Grams: "WESGASCO, ESTRAND, LONDON"

STOCK AND SHARE LIST

Official Quotations on the London Stock Exchange

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Dec. 27.	Rise or Fall on Week.	Transactions, Lowest and Highest of Week.
1,551,868	Stk.	Sept. 9	7	7	Alliance & Dublin Ord. ...	133—143	...	...
374,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb. ...	95—100*	...	...
557,655	,,	Aug. 12	7	7	Barnet Ord. 7 p.c.	165—170	...	...
300,000	1	Oct. 7	1 9/16	1 7/16	Bombay, Ltd.	1 1/16—1 1/16	...	...
178,480	Stk.	Aug. 12	9½	9½	Bournemouth sliding scale ...	222—232	...	...
550,050	,,	,,	7	7	Do. 7 p.c. max. ...	171—176	...	...
489,160	,,	,,	6	6	Do. 6 p.c. Pref. ...	150—155	...	...
50,000	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	82—87*	...	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	103—108*	...	...
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	123—128*	+2	124½
357,900	,,	Aug. 12	7½	7½	Brighton, &c., 6 p.c. Con. ...	170—175	...	...
649,955	,,	,,	6½	6½	Do. 5 p.c. Con. ...	156—161	...	...
205,500	,,	,,	6	6	Do. 6 p.c. 'B' Pref.	142—147	...	...
855,000	,,	Sept. 23	8	7	British Ord.	152—157	...	...
100,000	,,	Dec. 16	7	7	Do. 7 p.c. Pref.	153—158*	...	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	110—115*	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	96—101*	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	107—112*	...	...
200,000	,,	,,	17 6/8	3½	Do. 3½ p.c. Red. Deb. ...	98—100*	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1—3	...	...
100,000	10	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1—3	...	...
150,000	Stk.	June 24	4½	4½	Do. 4½ p.c. Deb. ...	83—88	...	86
626,860	,,	July 22	6	6	Cardiff Con. Ord.	133—138	...	...
98,936	1	Sept. 23	2 -	2 -	Colombo, Ltd., Ord.... ...	1 3/8—17/8	...	35/-—35/6
24,500	1	,,	1 4/8	1 4/8	Do. 7 p.c. Pref....	20/-—22/-	...	...
609,204	1	Oct. 7	- 11·48	- 11·48	Colonial Gas Assn. Ltd. Ord.	19/6—21/6	...	...
296,053	1	,,	1 3·30	1 3·30	Do. 8 p.c. Pref.	24/6—26/6	...	...
1,775,005	Stk.	Aug. 12	6	5	Commercial Ord.	100—105	...	104½
620,000	,,	Dec. 2	3	3	Do. 3 p.c. Deb. ...	85—90	...	...
286,344	,,	Aug. 12	5	5	Do. 5 p.c. Deb. ...	121—126	...	...
807,560	,,	Aug. 12	7	7	Croydon sliding scale ...	151—156	...	154—155
569,590	,,	,,	5	5	Do. max. div.	113—118	...	116
620,385	,,	Dec. 16	5	5	Do. 5 p.c. Deb.... ...	121—126*	...	...
239,000	,,	Aug. 12	5	5	East Hull Ord. 5 p.c.... ...	109—112	...	...
181,625	,,	Aug. 12	6	6	East Surrey Ord. 5 p.c. ...	132—137	...	...
175,609	,,	Dec. 16	5	5	Do. 5 p.c. Deb. ...	120—125*	...	...
19,313,481	,,	Aug. 12	5½	5½	Gas Light & Coke 4 p.c. Ord.	27/—28/-a	...	27/3—27/7½
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	88—91	...	90—91
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	106—109	...	...
8,602,497	,,	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	89—91	...	90—90½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	115—118	...	...
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	111—114	...	113—114½
270,466	,,	Aug. 12	6	6	Harrogate New Cons. ...	132—137	...	...
140,000	1	Sept. 23	1 7½	1 7½	Hongkong & China, Ltd. ...	1¼—1½	...	...
213,200	Stk.	Aug. 12	6	6	Hornsey Con. 3½ p.c. ...	130—135	...	...
5,600,000	,,	Nov. 4	14	8	Imperial Continental Cap. ...	183—193	...	186—188
223,130	,,	July 22	3½	3½	Do. 3½ p.c. Red. Debs.	92—97	...	...
285,242	,,	Aug. 12	8½	8½	Lea Bridge 5 p.c. Ord. ...	175—180	...	...
165,736	,,	Aug. 26	10	8	Maidstone 5 p.c. Cap. ...	182—192	...	...
63,480	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	79—84*	...	...
75,000	,,	Dec. 2	110	110	Malta & Mediterranean ...	205—215	...	...
392,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	98—103	...	...
231,978	Stk.	Aug. 12	5	5	M.S. Utility 'C' Cons. ...	108—113	...	...
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	100—105	...	...
360,075	,,	Dec. 16	4	4	Do. 4 p.c. Deb. ...	101—106*	...	...
148,955	,,	,,	5	15	Do. 5 p.c. Deb. ...	120—125*	...	...
125,000	—	July 1	3½	3½	Do. 3½ p.c. Rd. Rg. Bds.	97—100	...	...
675,000	Stk.	Nov. 18	†3	†3	Montevideo, Ltd.	48—53	...	...
225,000	,,	Aug. 12	7½	7½	North Middlesex 6 p.c. Con.	170—175	...	...
396,160	,,	Aug. 12	5	5	Northampton 5 p.c. max. ...	105—110	...	...
300,000	,,	Nov. 4	17	19	Oriental, Ltd....	163—168	...	...
416,617	,,	Dec. 16	8	8	Plymouth & Stonehouse 5 p.c.	159—164*	...	...
504,416	,,	Aug. 12	8½	8½	Portsm'th Con. Stk. 4 p.c. Std.	173—178	...	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	110—115	...	...
114,000	,,	July 22	5	5	Preston 5 p.c. Pref.	106—111	...	...
321,961	1	Sept. 23	...	1/-	Severn Val. Gas Cor. Ld. Ord.	22/—23/-	...	...
319,510	1	,,	...	- 10½	,, ,, 4½ p.c. Cum. Pref.	21/9—22/9	...	...
133,201	Stk.	Aug. 12	5	8½	Shrewsbury 5 p.c. Ord. ...	147—152	+5	150/—151
90,000	10	May 27	;3	;3½	South African...	3—4	...	...
1,061,779	1	Sept. 23	1 2/8	1 2/8	South East'n Gas Cn. Ld. Ord.	27/6—28/6	...	...
845,016	1	,,	- 10 4/8	- 10 4/8	Do. 4½ p.c. Red. Cum. Pref.	22/3—23/3	...	...
450,000	Stk.	Aug. 12	4	4	Do. 4 p.c. Red. Deb. ...	100—103	...	...
6,709,895	,,	Aug. 12	6½	5	South Met. Ord.	131—136	...	133—134½
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf....	147—152	...	151
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf....	105—109	...	109
1,895,445	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	87—90*	...	88—88½
1,000,000	,,	July 8	5	5	Do. 5 p.c. Red. Deb.	115—118	...	...
1,543,795	,,	Aug. 12	6	6	South Suburban Ord. 5 p.c....	129—134	...	132—133½
512,825	,,	,,	5	5	Do. 5 p.c. Pref....	121—126	...	...
500,000	,,	,,	4	4	Do. 4 p.c. Pref....	103—108	...	...
888,587	,,	Dec. 16	5	5	Do. 5 p.c. Deb....	120—125*	...	125
250,000	,,	,,	4	4	Do. 4 p.c. Deb....	103—108*	...	...
415,907	,,	Dec. 2	...	4	S. Western Gas & Water Ord.	22/6—24/6	...	...
160,523	,,	Oct. 21	...	...	Do. 4½% Red. Cum. Pref.	22/—23/-	...	...
110,000	,,	Dec. 16	4	4	Do. 4% Red. Deb. ...	98—103	...	...
647,740	,,	Aug. 12	5	5	Southampt'n Ord. 5 p.c. max.	115—120	...	116½
121,275	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	98—103*	...	...
350,000	,,	Aug. 12	5½	5½	Swansea 5½ p.c. Red. Pref. ...	112—117	...	116
200,000	,,	Dec. 16	6½	6½	Do. 6½ p.c. Red. Deb. ...	96—101*	...	...
94,000	,,	...	...	...	Do. 3½ p.c. Red. Deb. ...	96—101*	...	...
1,076,490	,,	Aug. 12	6⅔	6⅔	Tottenham and District Ord.	149—154	...	...
409,835	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	130—135	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
334,615	,,	Dec. 2	4	4	Do. 4 p.c. Deb. ...	100—105*	...	...
369,774	,,	Aug. 12	7	7	Uxbridge, &c., 5 p.c. ...	152—157	...	157
108,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	117—122	...	...
1,340,521	,,	Aug. 12	7	7	Wandsworth Consolidated ...	159—164	...	163
1,371,373	,,	,,	5	5	Do. 5 p.c. Pref. ...	121—126	...	125½
1,317,964	,,	Dec. 16	5	5	Do. 5 p.c. Deb. ...	121—126*	...	...
338,300	,,	,,	4	4	Do. 4 p.c. Deb. ...	102—107*	...	...
499,735	,,	July 8	6⅔	6⅔	Watford and St. Albans Ord.	149—154	...	...
200,000	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
200,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	135—140	...	...
200,000	,,	Dec. 2	4	4	Do. 4 p.c. Red. Deb.	98—103	...	...
100,000	,,	...	...	3½	Do. 3½ p.c. Red. Deb.	96—101	...	...
158,400	,,	Aug. 12	6b	5	Winchester W. & G. 5 p.c. Con.	114—119	...	...

a.—The quotation is per £1 of Stock. *b.*—Paid £3, including 10s. on account of back dividends. * Ex div.
† Paid free of income-tax. ; For year. § Actual for three months.

Continued overleaf

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STOCK AND SHARE LIST—Cont.

Stocks Officially Quoted on Provincial Exchanges

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Dec. 27.	Rise or Fall on Week.	Transactions, Lowest and Highest of Week.
BRISTOL EXCHANGE.								
347,756	Stk.	July 22	6	5	Bath Cons.	122—124	...	...
1,667,250	,,	July 8	5	5	Bristol, 5 p.c. max.	118—120	...	...
120,420	,,	Dec. 16	4	4	Do. 1st 4 p.c. Deb. ...	100½—102½*	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	100—102*	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	125—128*	...	...
274,000	,,	Aug. 12	5	5	Newport (Mon.) 5 p.c. max....	113—118	...	...
13,200	12	Aug. 26	8½	7	Pontyp'l Gas & W. 10 p.c. 'A.'	14½—15½	...	...
13,600	10	,,	6	5	Do. 7 p.c. 'B.'	11½—12½	...	...
40,000	10	,,	6	5	Do. 7 p.c. 'C.'	11½—12½	...	...
140,778	Stk.	Aug. 12	5	5	Weston-super-Mare Cons. ...	115—117	...	...
64,338	,,	June 24	4	4	Do. 4 p.c. Deb.	97½—99½	...	...
33,340	,,	,,	7½	7½	Do. 7½ p.c. Deb.	168—172	...	...
LIVERPOOL EXCHANGE.								
157,150	Stk.	Aug. 12	6½	5	Chester 5 p.c. Ord.	109—114	...	...
92,500	,,	June 24	4	4	Do. 4 p.c. Pref.	100—105	...	...
32,540	,,	,,	3½	3½	Do. 3½ p.c. Deb. ...	92—97	...	...
41,890	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	100—105	...	...
2,167,410	,,	Aug. 12	6	6	Liverpool 5 p.c. Ord. ...	133—135	...	...
245,500	,,	Dec. 16	5	5	Do. 5 p.c. Red. Pref. ...	103—108	...	...
306,083	,,	July 8	4	4	Do. 4 p.c. Deb. ...	105—107	...	...
106,280	,,	July 22	10	10	Preston 'A' 10 p.c. ...	206—216	...	...
188,219	,,	,,	7	7	Do. 'B' 7 p.c.	142½—152½	...	...
NEWCASTLE EXCHANGE.								
122,577	Stk.	Aug. 12	8	8	Blyth 5 p.c. Ord.	151—153	...	...
732,000	,,	Aug. 12	5	5	Hartlepool G. & W. Co. & New	115—117	...	...
2,061,315	,,	Aug. 12	5½	5	Newcastle & Gateshead Con.	25 —25 6*d*	...	...
682,856	,,	,,	4	5 4	Do. 4 p.c. Pref. ...	107—108	..	...
776,706	,,	Dec. 16	3½	3½	Do. 3½ p.c. Deb. ...	98½—100½*	...	...
277,285	,,	Oct. 21	5	5	Do. 5 p.c. Deb. '43...	105—106	...	...
209,820	,,	Aug. 12	8½	8½	South Shields Con.	171—173	...	...
299,542	,,	Aug. 12	6	*6	Sunderland 6 p.c. max. ...	129—131	...	...
NOTTINGHAM EXCHANGE.								
542,270	Stk.	Aug. 12	10	7	Derby Con.	175—185	...	...
55,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	100—105*	...	...
84,750	,,	Aug. 26	12	5	Long Eaton 'A' Ord. ...	150—160	...	...
50,000	,,	,,	10	4	Do. 'B' Ord. ...	130—140	...	...
20,000	10	June 7	5	5	Do. 5 p.c. Pref. ...	10—12	...	...
80,000	Stk.	,,	5	5	Do. 5 p.c. Deb. ...	117—122	...	...
SHEFFIELD EXCHANGE.								
10,000	Stk.	Aug. 26	10	10	Great Grimsby 'A' Ord. ...	220—230	...	...
6,500	,,	,,	10	10	Do. 'B' Ord. ...	220—230	...	...
79,000	,,	,,	10	10	Do. 'C' Ord. ...	205—215	...	...
1,736,968	,,	Aug. 26	6	6	Sheffield Cons.	140—142	...	...
95,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	100½—102½*	...	...

a The quotation is per £1 of Stock. * Ex div.

Supplementary List of Stocks and Shares not Officially Quoted

60,000	10	Sept. 9	10	10	Ascot 10 p.c. max.	22—24	...	...
58,680	10	,,	7	7	Do. 7 p.c. max.	14½—15½	...	...
90,000	—	Nov. 4	5	5	Assd. Gas and Water Ord. ...	21/—23/-	...	...
90,000	—	,,	4½	4½	Do. 4½ p.c. Cum. Pref. ...	21/9—22 9	...	...
17,000	Stk	Aug. 26	8	8	Bognor Orig. Ord. 'A' ...	164—174	...	...
62,210	,,	,,	8	8	Do. New Addl. 'A' ...	164—174	...	...
87,160	,,	,,	7	7	Do. New 7 p.c. max. ...	142—147	...	...
37,440	,,	July 22	10	10	Cam. Univ. & Town 10 p.c. max.	214—224	...	...
125,970	,,	,,	7	7	Do. 7 p.c. max.	161—166	...	...
39,025	,,	,,	5	5	Do. 5 p.c. max.	110—115	...	...
65,000	,,	Aug. 12	8½	7½	Eastbourne 'A' 5 p.c. ...	153—158	...	...
198,000	,,	,,	7	6	Do. 'B' 3½ p.c.	135—140	...	...
112,312	,,	,,	5	5	Do. 5 p.c. Pref.	120—125	...	...
130,000	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	118—123	...	...
250,000	1	Nov. 18	...	4	Gas Consolidation Ord. ...	20 6—22 6	...	...
250,000	1	,,	...	4	Do. 4 p.c. Red. Cum. Pref.	19 6—20 6	...	...
117,251	Stk.	Sept. 23	8 1/20	8 1/20	Gosport District Cons. ...	177—182	...	...
73,350	,,	,,	5	5	Do. 5 p.c. Pref.	113—118	...	...
24,000	30	Aug. 12	8½	8½	Great Yarmouth 8½ p.c. max.	53—58	...	...
59,400	30	,,	7½	7½	Do. 7½ p.c. max.... ...	43—46	...	...
51,160	Stk.	Dec. 2	5½	5½	Do. 5½ p.c. Deb.... ...	123—128	...	...
152,600	,,	Aug. 26	8	8	Guildford Cons.	170—175	...	...
54,055	,,	,,	5	5	Do. 5 p.c. Pref.	116—121	...	...
68,250	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	117—122	...	...
156,600	,,	Aug. 12	7½	7½	Hampton Court Cons. ...	170—180	...	...
81,660	10	Feb. 4	9	9	Leatherhead Ord.	16—17	...	...
107,960	10	Sept. 23	5	4	Mid Kent Ord.	9½—10½	...	...
230,445	Stk.	Aug. 12	10	10	Oxford & District Ord. ...	215—225	...	223—224
47,112	,,	,,	5	5	Do. 5 p.c. Pref.	117—122	...	...
50,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	115—120	...	...
126,193	,,	Nov. 18	7½	7½	Peterborough Ord.	160—170	...	170½—171
317,638	,,	Aug. 26	5	5	Reading 5 p.c. max.	108—113	...	...
85,000	,,	,,	5	5	Do. 5 p.c. Red. Pref. ...	105—110	...	...
64,990	,,	Sept. 9	7½	6½	Redditch Ord.	116—121	...	...
166,850	,,	Aug. 12	7	7	Romford Ord.	167—172	...	...
60,000	,,	,,	4	4	Do. 4 p.c. Pref.	97—100	...	...
44,000	,,	Sept. 23	5	5	Do. 5 p.c. Deb.	121—126	...	...
110,950	,,	Aug. 26	8	8	Ryde Ord.	168—173	...	...
236,191	,,	July 22	7	5	Scarborough Ord.	130—140	...	...
77,825	,,	Aug. 26	8	8	Shanklin & Ventnor Cons. ...	155—165	...	...
240,643	,,	Sept. 23	7	7	Slough Ord.	150—155	...	...
21,000	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	116—121	...	...
28,872	1	Nov. 4	5½	5½	S. Midland Gas Cpn. Ltd. Ord.	20/—22/-	...	...
28,866	1	Sept. 9	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	20/—22/-	...	...
124,930	Stk.	Aug. 12	7	7	Southgate & Dist. 7 p.c. max.	150—155	...	...
62,500	,,	,,	5	5	Do. 5 p.c. Pref.	117—122	...	...
117,228	,,	Aug. 12	6	5	Swindon Cons.	113—118	...	...
60,425	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	118—123	...	...
750,000	1	...	...	...	Utd. Kingdom Gas Cpn. Ord.	1 1/16—1 3/16	...	22/-
160,910	1	Nov. 18	...	2½	Do. 4½ p.c. Prefd. Ord....	...	...	...
910,910	1	,,	...	2½	Do. 4½ p.c. Cum. Pref. ...	...	...	...
400,000	Stk.	,,	...	...	Do. 3½ p.c. Red. Deb. ...	98—101	...	100
130,000	,,	Aug. 12	8	5	Wakefield Ord.	140—150	...	142
81,650	,,	...	5	5	Do. 5 p.c. max.	103—108	...	...
82,000	,,	July 22	6	6	Weymouth Ord.	101—106	...	...
370,000	,,	,,	6	4	York Cons.	107—112	...	...
90,000	,,	Dec. 16	5	5	Do. 5 p.c. Red. Deb. ...	103—108	...	...
133,640	,,	Aug. 12	6½	6½	Yorktown (Cam.) 5 p.c. Cons.	120—125	...	...
100,000	,,	,,	5	5	Do. 5 p.c. Pref.	117—122	...	...
35,000	,,	Dec. 16	5½	5	Do. 5½ p.c. Deb.... ...	126—131	...	...

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